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TO

M. CIVIALE,

MEMBER OF THE INSTITUT,

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The following Pages

ARE INSCRIBED AS A TRIBUTE OF RESPECT

TO THE

DISCOVERER OF LITHOTRITY, AND AS A GRATEFUL ACKNOWLEDGMENT OF

THE ASSISTANCE DERIVED FROM HIS VALUABLE LABOURS,

BY HIS

FAITHFUL FRIEND AND SERVANT,

THE AUTHOR.

PREFACE.

During the last year I delivered a series of Lectures on Lithotrity and Lithotomy, at St. Mary's Hospital. The greater portion of these Lectures was subsequently published in the "Lancet," and I have been encouraged to think that they may not prove unacceptable to the members of the Profession in an enlarged and separate form. I have, therefore, treated in a fuller manner such points as appeared to require further elucidation, and added some Lectures which have not hitherto been published. Although I have, to some extent, discarded the colloquial style which I adopted in lecturing, the repetitions incident to this mode of instruction will, I am aware, be still observable.

In its present form, the work will, I trust, be acceptable to many who have not time to study more elaborate treatises. My object has been to place before the reader, in a concise but complete manner, every practical point of importance connected with

Lithotrity and Lithotomy, and to draw an unbiassed parallel between these operations. I have not omitted anything that appeared to me essential to a perfect understanding of the important subjects which I have undertaken to discuss. To the works of Deschamps, Civiale, Wilson, and Crosse, I am indebted for many of the illustrations, which have been drawn and engraved with great skill by Mr. Gilks.

London: March, 1853.

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ON

LITHOTRITY AND LITHOTOMY.

CHAPTER I.

HISTORY OF LITHOTRITY.

THE modern operation of lithotrity consists in introducing certain instruments into the bladder through the urethra, in seizing with these instruments the calculus, in reducing it to fragments, and, finally, in promoting the expulsion of the fragments from the bladder. Before describing the operation, however, a few historical remarks may be interesting, for nothing is more curious or instructive than to follow the history of the mechanical destruction of stone through its successive epochs.

Lithotrity, in one sense of the term, is not a modern invention. It has been known, and occasionally practised, from time almost immemorial; but these isolated operations detract nothing from the merit of the illustrious surgeon of modern days, to whom the honour of having erected it into a system, incontestably belongs, and who may therefore be regarded, as he now universally is, the real inventor.

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The germ of lithotrity may be found in the old idea of extracting calculi from the urethra without a cutting operation. From the urethra to the bladder there is but a single step, yet it required more than a thousand years to make this step, short and simple as it may now appear.

Urethral calculi were sometimes extracted whole, sometimes broken up, to facilitate their extraction. Hippocrates mentions a certain Ammon, of Alexandria, who thus broke up calculi with a statuary's chisel, from which circumstance he was named the "Lithotomos."

Albucasis, a Moorish surgeon, who lived in Spain at the latter end of the eleventh century (1090), describes the operation of perforating and breaking up urethral calculi. He recommends that the penis be tied between the calculus and the bladder, to prevent the stone from being pushed backwards. This done, he directs the stone to be perforated with a kind of bore (*terebra*).

Franco, in the year 1561, repeated the advice of Albucasis, and gave the drawing of an instrument for perforating the calculus, which he appears to have borrowed from Guido de Cauliac (1546). Franco also mentioned that when the calculus was perforated at one side, the operator should endeavour to turn it, and perforate it again in another direction, so as to reduce it more easily into fragments.

Franco also employed an instrument which he calls *vesical à quatre* (quadrupulus vesicæ), for the extraction of calculi from the bladder (Fig. 1). This was composed of an iron rod supporting four branches at its extremity, and enclosed in a canula; when pushed forward the branches opened sufficiently to grasp a

stone as large as an egg. Franco modestly says, "That this instrument was the invention of his cousin, and that he merely modified it;" remarking, what many modern inventors seem to have forgotten, "that it is easier to add than to invent."

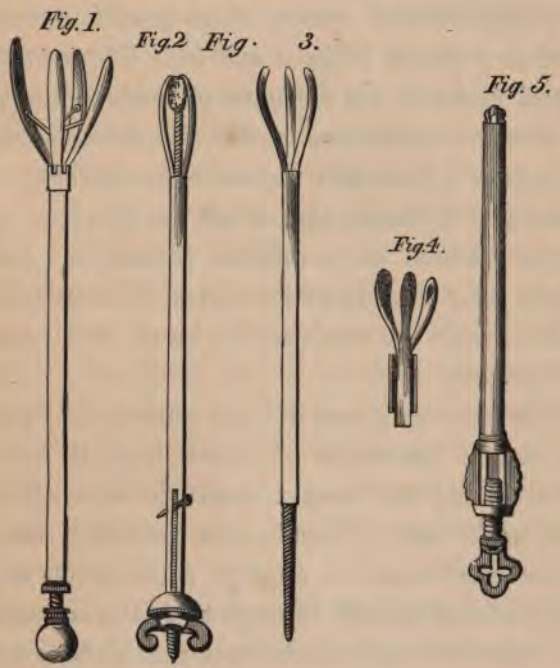


Fig. 1.—The quadrupulus vesicæ of Franco (1561), for the extraction of calculi from the bladder.

Figs. 2 and 3.—The forceps of Fabricius Hildanus, for the extraction of calculi from the urethra (1593). Fig. 2, shows the forceps shut and grasping the stone. Fig. 3, the three-bladed canula.

Figs. 4 and 5.—The ball-extractor of Alphonso Ferri (1553). Fig. 4, the blades. Fig. 5, the instrument enclosed in its canula.

Fabricius Hildanus reduced the branches of this instrument from four to three (see Figs. 2 and 3), and M. Hales from three to two. Instruments on the same principle and of the same kind were invented, or, to

speak more properly, brought forward by many other surgeons, and, in modern times, by Hunter and Sir Astley Cooper.

It is probable that all these instruments were originally derived from the ball-extractor of Alphonso Ferri (1553), which was a three-branch instrument enclosed in a canula (Figs. 4 and 5). This instrument contained many of the elements of modern lithotriptic instruments—the external canula, the three-bladed forceps received into it, and the screw for working. The instrument of Hildanus also shows the fly-screw, which has been claimed as a modern invention. Loiseau, who lived near the end of the sixteenth century, broke up a calculus in the urethra of a monk, and extracted it in fragments.

But the older surgeons did not confine their practice to the simple extraction of calculi from the urethra. It is certain that they sought to extract stones from the bladder itself, and it seems even probable that they sometimes perforated or crushed such calculi as were too large to find an exit through the natural passages.

The extraction of calculi from the bladder without breaking them up, was practised in Egypt from time immemorial: the French surgeons who accompanied Bonaparte in his Egyptian expedition saw the operation performed there, and it is probably practised in that country at the present day. But this would evidently apply to small calculi only. Was the operation of perforating and crushing larger calculi known to the older surgeons? Upon this point some doubt may be expressed, although several passages in the older writers appear to led to the conclusion that the method was

occasionally either practised, or at all events, theoretically entertained.

Albucasis, who died in the year 1105, may have been acquainted with the operation of lithotrity when he wrote the following passage :—"Accipiatur instrumentum subtile quod nominat Mashabra Rebilia, et suaviter intromittatur in virgam, et volve lapidem in medio vesicæ, et si fuerit mollis, frangitur et exibit."

From the context of Albucasis, however, it would appear that the operation of which he speaks, referred to the relief of retention of urine produced by the impaction of a small calculus either in the neck of the bladder or in the urethra. In such cases, he says, "The calculus is to be pushed back into the bladder, and if it is friable it breaks up and is expelled. But if it be not expelled, the patient must be cut." It is impossible to ascertain the nature of the instrument to which Albucasis alludes, his Latin translator having preserved the original Arabic name, apparently from not understanding what it meant.

In the year 1506, Antonio Benevieni performed the operation of percussion, for the introduction of which, in modern times, we are indebted to Baron Heurteloup. The patient, however, was a female, and the stone appears to have been impacted near the neck of the bladder. Benevieni passed a hook behind the calculus, so as to fix it, and then struck the calculus with an iron rod, until by the repeated blows it was broken into pieces. "Uncum calculo injecio ne silicit concussus iterum in vesicam revolveretur. Tum ferramento priore parte retruso, calculum ipsum percutio donec sæpius ictus in frustra comminuitur."

In 1533, Alexander Benedetti thus alludes to perforation: "Cum vero his præsidiis (dissolventibus) lapis non comminuitur, nec ullo modo eximitur, curatio chirurgica adhibeatur, et per fistulam, priusquam humor profusus dolores levet, aliqui intus, sine plagâ, lapidem conterunt ferreis instrumentis, quod equidem tutum non invenimus."

Sanctorius, who lived in the early part of the 17th century, is generally stated to have invented several instruments for perforating calculi in the bladder.

Haller thus alludes to them in his "Bibliotheca Chirurgica"—"Catheterem delineat trifidum, per eum in grandiorem calculum specillum sagittatum immittit: eo, ut putat, calculum dividit, ut fragmenta inter specilli crura cadant et possint extrahi." But Haller adds, "meram speculationem puto."

This is an extremely curious passage. Haller evidently quoted Sanctorius from memory, for, on referring to the original work of this latter author, it will be found that his instruments were solely intended for the extraction of small calculi from the bladder, and that the arrow-headed stilet merely served to expand the branches of the three-bladed forceps. The idea of perforating the calculus, and extracting its fragments was a creation of Haller's own genius, which he attributes to Sanctorius, and calls "a pure speculation." Yet, one hundred years afterwards, this speculation was converted into a reality. It would hence appear, that the original idea of lithotrity, as a system, belonged to Haller, but that Haller attributed his own idea to another, and discarded it as a fancy.

Figs. 6, 7, 8.—Sanctorius' instruments (1626) for the extraction of stone from the bladder. Fig. 6, the perforator closed. Fig. 7, the barbed stilet. Fig. 8, the forceps for extracting the calculus.

In 1671, Ciucci, an Italian surgeon, speaks of a "tenacula tricuspis" (as the most effectual mode of curing stone), with which the calculus was seized and broken up into fragments.

In 1791, Thomassini established the possibility of breaking up small friable calculi in the bladder; and it is asserted that a Spanish surgeon, named Rodriguez, performed this operation at Malaga in the year 1800. The well-known facts of Colonel Martin and the Citeaux monk, I need merely allude to; the former delivered himself from calculus by filing the stone, the latter by percussion. Sir Philip Crampton mentions a fact long

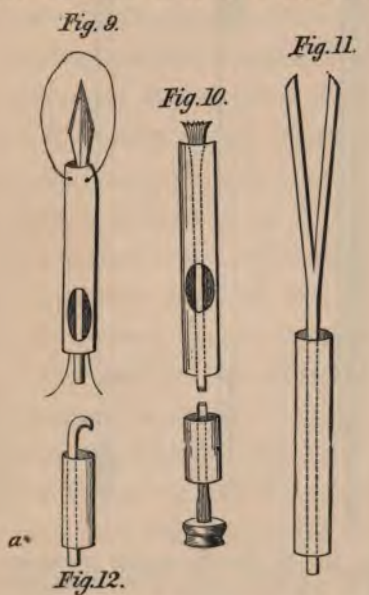
anterior to either of them—the history of an Irish gentleman, in 1559, who was cured of stone by some instruments passed into the bladder, and employed to break up the calculus.

These are all isolated facts. It is impossible to determine from them the precise nature of the operation employed, or whether it was ever converted into a system. Besides, they were completely forgotten or unknown.

In 1813, M. Gruithuisen, a Bavarian surgeon, published two memoirs on lithotrity in the *Saltzburg Medico-Chirurgical Gazette.* These were remarkable productions in every respect; and if M. Gruithuisen did not discover lithotrity, we must at least acknowledge that he was very near doing so. On looking at the drawings of his instruments, we perceive a straight canula, intended to pass into the bladder, and serve as a conductor for a perforator, which was either lance-shaped or dentated, a wire for seizing and fixing the calculus, a handle rapidly moved by a bow drill, a branched forceps and a hook for the purpose of crushing the fragments of stone when divided by the perforator.

Here, then, for the first time in the history of lithotrity, we find a whole and complete system, embracing all the essential parts of the operation, such as it is performed at the present day; and we may conclude that if M. Gruithuisen had possessed but a tithe of the perseverance displayed by M. Civiale, the honour of having discovered lithotrity would have belonged to Germany, not to France. It should, however, be observed that the operation of lithotrity could never have been performed

with the apparatus invented by Gruithuisen. The wire could never seize a calculus, and the forceps, from its shape and construction, could have little, if any, crushing power. It does not appear that the instruments were ever tried on the dead body,—certainly not on the the living; the project received little attention, and was soon forgotten, like those which had preceded it. Besides, it does not appear that M. Gruithuisen's proposal exercised any influence on the subsequent discoveries of Civiale, to whom it was entirely unknown, and it is quite obvious that it would have remained

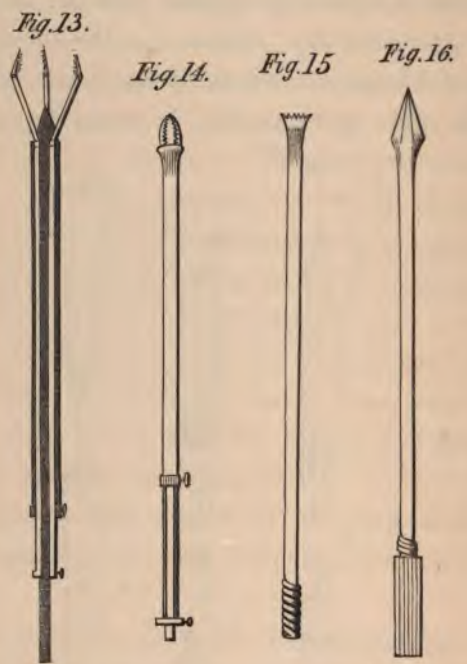


Figs. 9, 10, 11, and 12.—Gruithuisen's instruments for perforating and crushing calculi. (1812-1813.) Fig. 9, the canula, perforator, and wire loop for fixing the calculus. Fig. 10, the canula, containing a toothed perforator.
Fig. 11.—Gruithuisen's forceps for crushing the calculus after it was perforated.
Fig. 12.—His hook for crushing fragments against the end of the canula.

a barren speculation, perhaps for centuries, had not the genius of the French surgeon been directed to the sa

point, while his perseverance conducted him through a host of difficulties to a triumphant application of the principle.

The first idea of endeavouring to cure stone in the bladder, without having recourse to the knife, seems to have presented itself to M. Civiale in the year 1817. He was then a medical student of very limited means,



Figs. 13, 14, 15, 16.—M. Civiale's *original* instruments, as designed in his Memoir of 1818. Fig. 13, a section of the six-bladed forceps for seizing the calculus; the lance-jointed stilet is seen in the middle. Fig. 14, the instrument when closed. Fig. 15, a dentated perforator. Fig. 16, a lance-shaped perforator.

and employed as an externe under Dupuytren. Having made a few experiments, and constructed some models in wood, he made an application to the French Minister, in July, 1818, for pecuniary aid towards con-

structing his instruments; and at the same time forwarded a short Memoir, with drawings, entitled, "Some Details of a Lithontriptic." The drawings of three different instruments were attached to the Memoir; but I need only notice one of them, as the other two were of little or no value. This instrument consisted of two hollow metallic tubes (see drawings), gliding on one another, the internal one supported at its vesical extremity six elastic steel branches, slightly curved at the end, and solidly fixed to the inner tube. In the original drawing these branches are shown as being joined to the tube by hinges; but this was an error of the artist, for the text distinctly states that they opened by their elasticity; nor is any allusion whatever made to hinges. The *lithotriteur* was a long steel rod, either lance-shaped or dentated—in fact, exactly like those of Gruithuisen—fixed in a handle, which, it would appear, was to have been worked with the fingers alone. There was also a strong button-screw at the external end of the instrument, to control the movements of the tubes on each other; but neither the screw nor handle are depicted in the original drawing.

The Minister of the Interior sent, as is the custom, M. Civiale's Memoir to the Faculty of Medicine, who appointed Barons Percy and Chaussier to report on it; but these gentlemen took no notice whatever of the poor student's invention. His Memoir remained forgotten in the archives of the Faculty.

Had M. Civiale contented himself with his first project, it is evident that he would now be entitled to even less merit than Gruithuisen; but he was supported by the firm conviction that the principle of lithotrity

was a valuable one, and, being endowed with great perseverance, he continued his researches with the very limited means at his command. In 1819, he reduced the six branches of the forceps to four, and in 1820, to three; in the same year, also, he added a bow-drill, and made several other improvements of minor importance. With these improved instruments numerous experiments were publicly made during the early part of the year 1822, at the Hospital of La Pitié, and in the dissecting rooms of the Faculty. Many young men, who subsequently distinguished themselves, were present at all these experiments; and it is not going too far to imagine that M. Amussat and M. Leroy had become acquainted with their object, if not with the means employed to attain it. We thus find M. Civiale engaged since the year 1818, in successively improving his original instruments, and in making experiments with them on the dead body.

In the announcement of the principle, he was closely followed by Mr. Elderton, who published, in the April number of the *Edinburgh Medical and Surgical Journal*, 1819, a proposal for attacking calculi with a curved two-branched instrument and a perforator. The invention of Mr. Elderton was considered at the time a mere speculation, and even passed over without attracting any attention whatever.

It would hence appear that the idea of getting rid of urinary calculi by mechanical means, and without operation, presented itself in the early part of the present century, and about the same time, to a German, a French, and an English surgeon: to Gruithuisen in 1813, to Civiale in 1817, to Elderton in 1819. For two out of

Fig. 17.

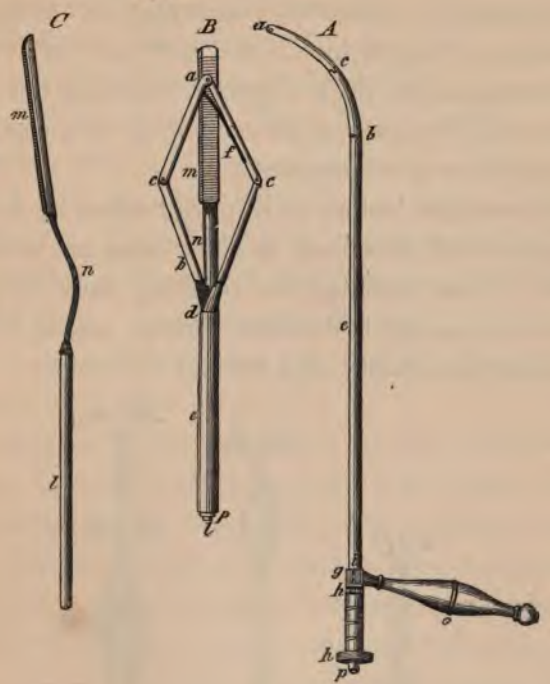


Fig. 17.—Mr. Elderton's instrument for crushing calculi (1819). That part which forms the curve (*a*, *b*, fig. *A*) consists of two blades (*c*, *c*, fig. B), placed laterally to each other, and which, when in contact, present a solid, round form (*c*, fig. *A*), to about the size of a large bougie. At that extremity of the curve, answering to the point of the catheter (*a*), the blades are connected by a joint; one blade being received within the other, and presenting this united and uniform smooth point. At an equal distance (*c*, fig. *A*), between the commencement of the curve (*b*), and its extremity (*a*), a second joint connects the other half (*c*, *b*,) of the same side. This structure is common to both the right and left blade. At the commencement of the curve (*b*) there is another joint (*d*), uniting the two blades, which are here fixed to a hollow metallic tube, made to slide readily within an outer canula (*b*, *g*, fig. *A*). A small steel spring (*f*, fig. *B*), placed within the blades, at their extreme point, expands them, and then they present an opening of an ovate shape (*a*, *c*, *b*, *c*, fig. *B*). The blades may be regularly and firmly closed, by simply drawing the inner tube within the outer one, while by pushing down the second tube, the blades may be expanded as before. When thus expanded, they constitute a pair of forceps (*c*, *c*, fig. *B*), well adapted, from their shape, capacity, and strength with which the blades may be closed, to grasp, and hold firmly, a moderately-sized calculus. The only remaining part of the instrument is the rasp for filing down the calculus supposed to be secured in the bladder by the forceps. To a steel rod (*l*, fig. *C*), is screwed a rasp (*m*), supported on a curved spring (*n*). The use of this spring is to keep the rasp in constant contact with, and pressure upon the stone; which, how much soever diminished by friction, will still, from this method, have the rasp acting firmly upon its under surface.

the three, the idea remained unproductive; the French surgeon had the merit of converting the theory into a practice. We left him in the early part of 1822, experimenting at the Ecole Pratique, attacking the hardest stones, and breaking up those as large as a small hen's egg, after five or six attempts.

Such was the history of lithotrity when M. Amussat, in April, 1822, described in a few lines an instrument which he had invented for crushing stone (Fig. 18). This was a strong, two-bladed forceps, acting laterally, concealed in a canula, and worked by a lever.

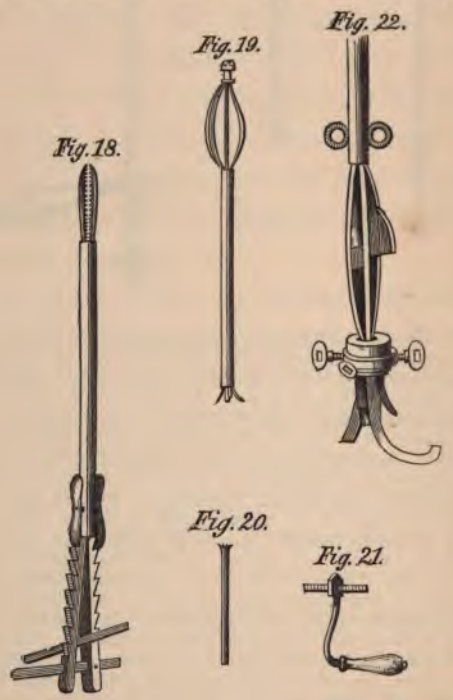


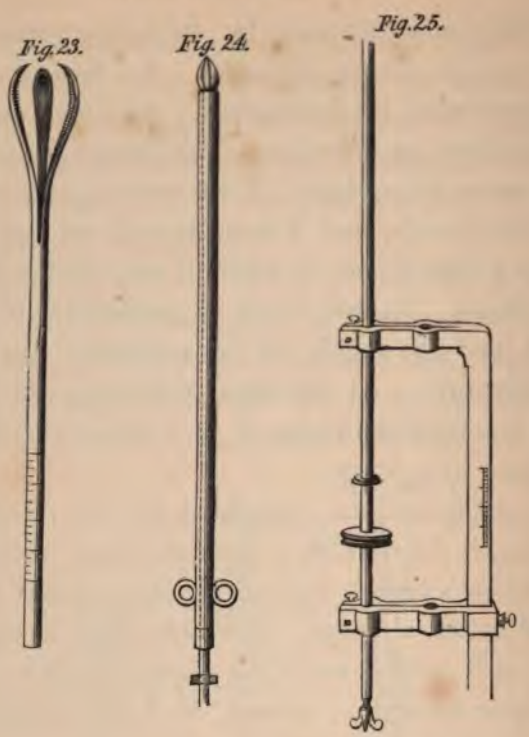
Fig. 18.—M. Amussat's crushing forceps (April, 1822).

Figs. 19, 20, 21, 22.—M. Leroy d'Etiolles' perforator (June, 1822). Fig. 19, the vesical end, showing the watch-springs expanded. Fig. 20, the dentated perforator. Fig. 21, the handle to work the perforator. Fig. 22, the external extremity, showing the springs fixed by screws.

He was soon followed by M. Leroy, now better known as M. Leroy d'Etiolles. In June, 1822, M. Leroy produced his instrument. An outer canula of silver enclosed an inner one, which latter again enclosed four long watch-springs. These were passed up along the inner canula, and formed beyond its vesical extremity a kind of net, in which it was proposed to fix the calculus. Several kinds of perforators were employed, and the handle of the perforator was turned by a bow-drill. At the distal extremity, the springs which represent the blades of M. Civiale's forceps were fixed each by a screw.

A commission was appointed by the Academy of Medicine, in July, 1822, to examine these instruments. M. Amussat's broke; that of M. Leroy seems to have worked better, although it is evident, from its construction, that it could never hold a permanent place amongst lithotriptic apparatus; indeed, M. Leroy abandoned it at once, and in April, 1823, he produced a much better instrument (Figs. 23, 24, 25). It is an imitation of Alphonso Ferri's ball-extractor. The forceps blades are exactly the same; the tube is merely hollowed, instead of being solid, to receive the perforator which M. Leroy added.

The appearance of this latter instrument, and the claims which M. Leroy set up on it, drew M. Civiale from the silence which he had hitherto observed; for it is necessary to remark, that up to May, 1823, he had not published a single line on lithotrity. To the short work on "Retention of Urine, Urinary Calculi, and the possibility of destroying Calculi in the Bladder without Operation," he appended the original Memoir of 1818,



Figs. 23, 24, 25.—M. Leroy's improved instruments (April, 1823). Fig. 23, the forceps. Fig. 24, the instrument closed. Fig. 25, the handle for holding the drill, mounted with a pulley for a bow-drill.

with the original drawings ; and also indicated, in a very summary manner, the improvements which he had made since 1818.

It is not easy to understand why M. Civiale did not describe his improved apparatus in a clearer manner. Perhaps he did not think it prudent to communicate at that time all he knew to professional men, who had already evinced so strong a determination to refuse acknowledging his merits. However this may be, we are compelled to take for granted the conclusions of

Baron Percy's report in 1824. In January of that year, M. Civiale addressed to the Institut a Memoir, which was immediately referred to Barons Percy and Chaussier, the same reporters who had been appointed by the Faculty of Medicine in 1818. This time, M. Civiale was more fortunate. On the 13th of January, he performed his first operation in the presence of the commissioners, and the patient was freed from his stone in two sittings. In the second patient operated on (February 4), the stone was removed in four sittings. The third patient was cured with equal expedition on the 4th of March. Such brilliant and unexpected success attracted immediate attention. On the 22nd of March, the reporters, having the original documents of 1818 in their possession, examined the various modifications of M. Civiale, together with the proofs which he offered, and sent in a report, which establishes M. Civiale's right, not only to the discovery of the principle, but of the means by which it has been carried into practice. Envious men and rivals have endeavoured, from time to time, to attack the validity of this report ; but if two of the most distinguished surgeons in France, totally disinterested, and having all the documents, &c., at their command, arrived at a certain conclusion, it is difficult to see why others, deprived of the same means of judging, should presume to overthrow it.

M. Civiale, then, is to be regarded as the discoverer of lithotrity. It is unnecessary to insist further on this point, or on the different modifications which his instruments have undergone ; for although lithotrity as a system was originally established with straight instruments, and on the principle of perforation, the system

almost universally adopted rests on curved instruments and the principle of crushing.

Lithotrity in its true sense is made up of two principal parts—seizing the stone in the bladder, and destroying the stone. This latter part may be effected by perforation, by percussion, or by crushing; and the predominance of any of these three modes of attacking the stone constitutes a peculiar method, although in particular instances they may be combined together with advantage.

The attempts made by the older surgeons to crush stone in the bladder have been already noticed. According to M. Bellinaye, an English surgeon, named Stoddart, had a sliding instrument constructed in 1800, for the purpose of crushing calculi. In 1813, Gruithuisen produced his forceps, but the blades acted laterally, and all the urethral forceps previous to the year 1824 were constructed on the same defective principle. M. Civiale used a *brise-pierre* in 1821. It was worked with a rack and pinion, but the branches were movable, and acted laterally. In 1822, M. Amussat published an account of his crushing forceps, to which I have already alluded. The first crushing instrument of any value—that is to say, one in which the blades are placed one over the other, and have a gliding movement forwards—was, as far as I can ascertain, manufactured by Mr. Weiss, in the year 1824 (Fig. 27). According to Mr. Weiss's account, it is essentially the same as the improved percussor of Heurteloup, with this difference only, that it acts by crushing with a screw instead of percussion.

It should perhaps have been observed, that M. Civiale asserts he always used more or less crushing when the

Fig. 26.

Fig. 27.

Fig. 26.—M. Civiale's improved instruments (1824).
Fig. 27.—Mr. Weiss's original instrument (1824).

calculus was perforated and reduced into fragments; he then crushed these with the blades of his three-branched forceps against the extremity of the canula. This was a very imperfect method.

Dr. Haygarth comes next. In 1825 he invented a sliding instrument, for the purpose of extracting small calculi from the bladder, and, at the suggestion of Mr. Hodgson, a screw was attached to this instrument, that

Figs. 28 and 29.

Figs. 28 and 29.—Dr. Haygarth's instrument for crushing stone (1825).

it might be employed for crushing. Mr. Hodgson tried this instrument upon a patient in the Birmingham Hospital in 1825.

To a provincial English surgeon is thus due the honour of having been the first to perform the operation of crushing as it is now employed, and of appreciating the value of the screw at a time when one of the principal surgeons in London caused it to be laid aside as a dangerous mechanical principle.

In the same year a French instrument maker, named Retoré, invented a sliding instrument for crushing calculi, a description of which M. Leroy D' Etiolles published in 1827. The curve of this forceps seems to have

formed almost part of a circle, and it broke whenever attempts were made to employ it on the dead body.

The instrumental portion of the crushing system unquestionably originated in England, for we do not find crushing as a system alluded to in any of the French publications previous to 1829. To render this system available, the blades of the forceps must be placed in the same plane, one behind the other; the motion must be sliding from behind forwards, and the male piece should glide along a hollowed catheter. These three conditions were first obtained in the English instruments, and the system of crushing thus rendered capable of being executed in a perfect manner.

In 1831 Professor Jacobson, of Copenhagen, presented his articulated crushing instrument to the Institut; several successful operations were performed with it, but it is now abandoned. The principle was altogether different from that of the sliding instruments at present in use.

Indeed, true crushing does not seem to take date as a complete system until after the production of Baron Heurteloup's percussor in 1832. On employing that instrument, surgeons soon perceived that it might be applied to crush the stone. Some, as M. Tonsay in France, modified it, so as to render it available for percussion or crushing; while others, especially our English surgeons, returning to the principle of Mr. Weiss, abandoned percussion, and substituted in its place crushing, either by pressure with the hand alone, or with a screw, or fly-screw, &c.

The intuitive genius of Dupuytren was one of the first to seize the advantages of pressure. Soon after the

appearance of Baron Heurteloup's percussor, we find Dupuytren writing to him the following passage:—"If you could discover a mode of substituting for percussion a force of pressure which would enable us to do away with your bed, &c., I should at once advise the commission to award you the grand prize." As for percussion, Baron Heurteloup is unquestionably entitled to the merit of having, if not discovered, at least introduced and subsequently established that system, which led to the still better one now adopted, of

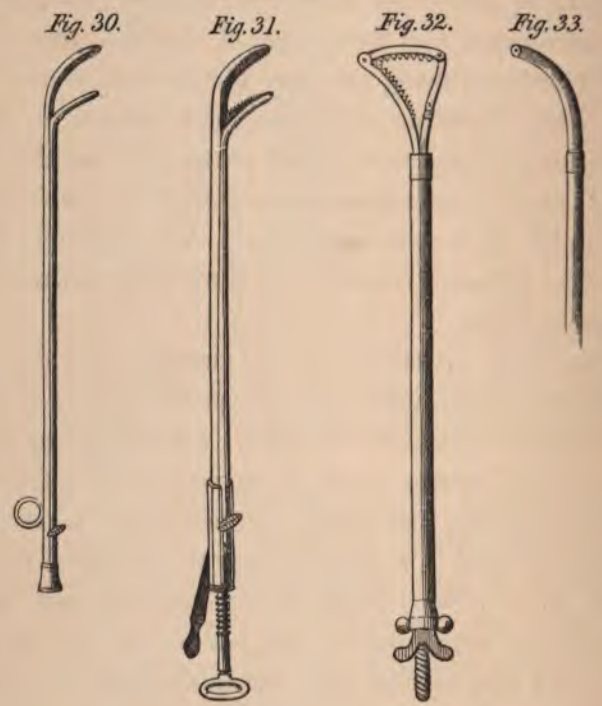


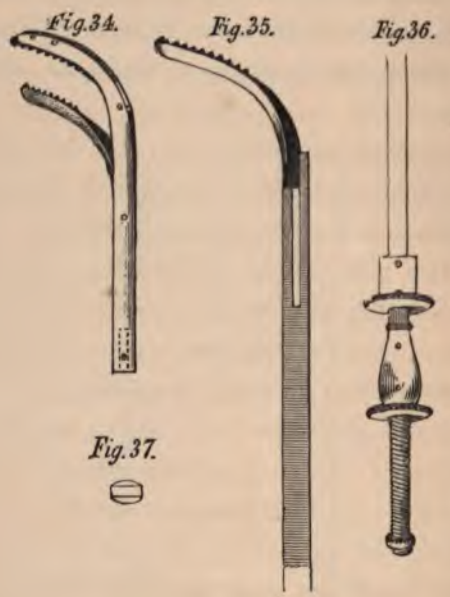
Fig. 30.—Mr. Weiss's catheter-forceps.
Fig. 31.—Mr. Weiss's screw-scoop.
Fig. 32.—Professor Jacobson's instruments (1831).
Fig. 33.—Shows instrument closed.

crushing with sliding instruments. And here I must enter into a few details which enable me to do justice to English surgery on a point that has been forgotten or intentionally overlooked.

Baron Heurteloup's original instrument was extremely imperfect; and I have no hesitation in affirming, that, without the essential modification which it subsequently received, it could never have held its place, and the system of percussion must have been abandoned as impracticable.

The accompanying drawing is taken from the original instrument made by Weiss, and which Baron Heurteloup presented to the Westminster Society. It is composed of two side-pieces, with a thin central plate of steel, representing the male branch. The side-pieces are curved at their extremities, and are united to the central piece by the pressure of a few screws. Near the curve of the male-piece is a short longitudinal slit, through which a rivet passes from side to side, and this is the only solid point of junction. This rivet limits the movement of the branches. From the section of the instrument it will be seen that the side-pieces, which represent the female branch, do not meet either above or below, but are separated by the thickness of the male branch. The sliding movement is altogether lateral. Now, let us consider for a moment what takes place—nay, what actually did occur in Colonel Rankin's case—with this instrument. When the blades embrace a calculus, and pressure or percussion is employed, a tilting effect is produced at that part of the slit in the male branch which comes in contact with the rivet, the rivet acts as the point d'appui of a lever, and the extre-

mity of the male forceps is more and more thrown up according to the force employed. In the case alluded to, it was bent upwards over the arch of the pubes. This is the inevitable effect of the want of solidity, produced by the way in which the branches slide laterally, and by the lever action of the connecting rivet.



BARON HEURTELOUP'S ORIGINAL INSTRUMENT FOR PERCUSSION.

Fig. 34.—The male and female branches, without handle and opened. The dotted lines show the slit in the male branch.

Fig. 35.—The vesical extremity of the male branch; the slit in the blade enables it to be drawn back.

Fig. 36.—The handle and portion of instrument.

Fig. 37.—Perpendicular section showing the central or male branch, and the external or female side-pieces.

These fatal defects were soon modified by Dr. Costello, who presented his improved instrument to the Westmin-

ster Medical Society, on the 8th of December, 1832. It differed little from the instruments now employed, being composed of two pieces of steel, instead of three as was Baron Heurteloup's. The female branch resembled a hollow catheter, with a small sharp curve; and to allow of the introduction of the male branch, a longitudinal slit was carried from one extremity to the other along the upper surface. The male branch was a solid piece of steel, which fitted exactly into the female one, with all the points of which it was in close contact, except of course along the groove; but here the edges of the groove in the female branch slightly overlapped the body of the male one, and the latter was thus kept firmly in its place; this solid manner of uniting the two branches while they slide, enabled the operator to employ any degree of pressure without danger of forcing the joints or branches of the instrument.

Fig. 39 *a*

Fig. 39.

Fig. 38.

d

Fig. 38.—Dr. Costello's percutor. A, the handle; B B, the male branch; C, the female branch.

Fig. 39 *a* shows a section of the male and female branches with the vice.

Fig. 39 *d* shows a section of the female branch.

Dr. Costello also removed the teeth from the concavity of the female branch, and placed them along its edges.

The instrument now described enabled the surgeon to employ crushing with perfect safety, and it may be

regarded as the starting point for all those subsequently introduced. It is, however, but justice to state Mr. Weiss positively affirms that his original instrument of 1824, was composed of two pieces sliding on each other in exactly the same way as Dr. Costello's, while the latter gentleman asserts, in an equally positive manner, that the instrument shown by Mr. Weiss to the Westminster Medical Society in 1832, was constructed on the same defective principle as that of Baron Heurteloup, that is to say, with two lateral pieces and a central male one sliding vertically between them.

Mr. Weiss, at all events, was the first who formed an idea of the advantages of the screw; and it is curious to observe how the progress of lithotrity in this direction was retarded by what we might call an accident. In the year 1824, Mr. Weiss demonstrated the power of his screw instrument to Sir Benjamin Brodie. The screw acted with so much power on a hard calculus, that it was feared the bladder might be injured by the force with which the fragments would be propelled against its walls; and to obviate such an occurrence Sir Benjamin suggested the addition of a saw.

Fig. 40.—Mr. Weiss's instrument for sawing stones in the bladder (1825).

The principle of crushing by means of the screw was, however, rejected for the time; no trials were

made on the living body, and it was not until 1832, when the public use of Baron Heurteloup's percutor had refuted the theory of "danger from explosion of fragments," that Mr. Weiss's principle began to attract attention, and was finally converted into a method.

From this brief sketch, it will be seen that England may claim the chief part in the introduction of the crushing system. The oval slit in the side or back of the female forceps, for the discharge of detritus, was, I believe, invented by the late Mr. Oldham, a gentleman attached to the Bank of Ireland; while Mr. L'Estrange, of Dublin, claims the merit of having first applied a wire stilet for the purpose of removing the detritus. Mr. L'Estrange also claims the honour of having been the first to apply the principle of the screw as a means of crushing calculi in the bladder: but I cannot see on what this claim is founded. If Mr. L'Estrange's invention bears date from July, 1834, I have merely to remark that the screw was employed by Weiss in 1824, by Haygarth in 1825, again by Weiss in 1825, by Retoré in 1825, and by numerous French surgeons in 1833.

Since 1834 many changes have been made in the details of various parts of lithotritic instruments, but none affect the principle on which they work. The blade of the female branch has been made wider and deeper, to receive the detritus; the screw has been replaced by the rack and pinion; the latter furnished with a round handle, as in Charrière's, or with a T-shaped one, as in the English instrument, to give it additional force.

It is unnecessary for me to notice all these improvements, as they have been called, for almost every

surgeon who has occupied himself with lithotrity appears to have thought it incumbent on him to make some change in the apparatus—occasionally for the better, often for the worse.

A few words concerning Baron Heurteloup's percutor, and the operation of percussion, are necessary, although the original cumbersome apparatus is never used at the present day. Baron Heurteloup considered the position of the patient as a matter of importance, and invented a peculiar couch or bed of a rectangular form.

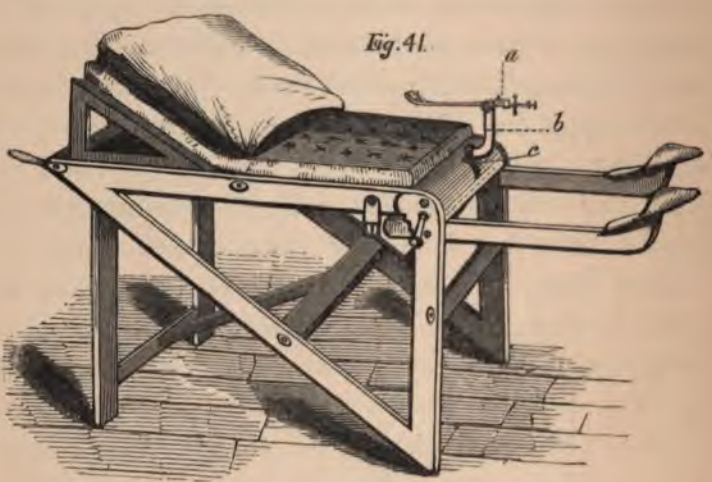


Fig. 41.—Baron Heurteloup's bed. *a*. The percussor, fixed by a screw in the upright rod, *b*. *b*. The upright rod, or "fixed point," which is itself firmly fixed to the framework of the couch by a wedge, *c*, driven in.

On the upright rod, which M. Heurteloup calls his "fixed point," is a wedge to fix this branch solidly, and a grooved head, with a screw at the upper end of the branch, to fix the percussor. The object is to hold the percussor so steadily, that when the male branch is

struck with the hammer, no movement of any other portion except the male branch shall take place. Anteriorly there are two pieces of wood, having at their extremities two slippers for the patient's feet. These can be lengthened or shortened at pleasure, to suit the height of the patient. In front there is a cross piece of wood, very thick, uniting the two triangles together. In this is seen a mortice for the small vice to play in, which holds the instrument during its action on the stone. This bed can be lowered, if required, to an angle of 45°, a strap being passed behind the neck and before the shoulders, and attached to a buckle on each side of the bed, so as to prevent the patient slipping off.

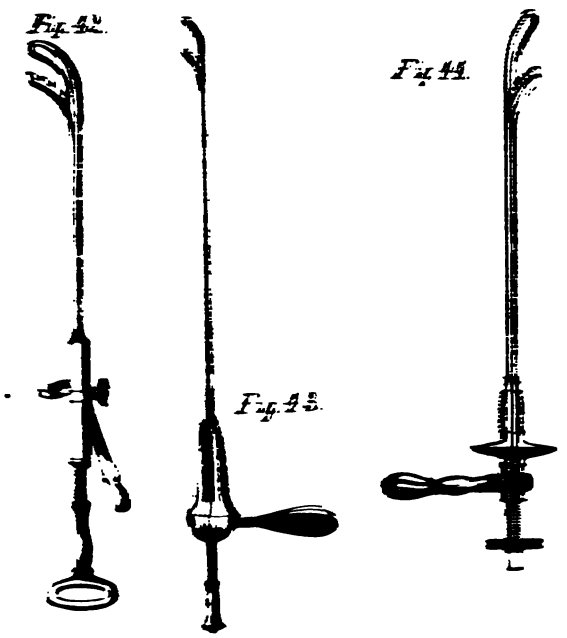


Fig. 42.—Weiss's most improved lithotrite.
Fig. 43.—The English rack and pinion.
Fig. 44.—Charrière's rack and pinion.

When the patient has been properly fixed, the extremity of the male branch is struck with repeated blows of a small hammer, until the calculus is sufficiently disintegrated by the effects of the percussion. Baron Heurteloup's method is very seldom employed at the present day, but it may become an useful auxiliary in cases of large and very hard calculi.

The instruments generally used at the present day for performing lithotrity are, the common screw one,

Fig. 45.—M. Civiale's latest instrument for crushing with the hand or the screw, or for employing percussion.

Fig. 46.—The jointed catch, which is shown *in situ*, on the instrument, fig. 45 *a*.

CHAPTER II.

THE PREPARATORY TREATMENT.

HAVING thus comprised, in as a brief a space as possible, the principal facts connected with the history of lithotrity, I hasten to its practical application. In a subsequent chapter I shall explain in what cases lithotrity is to be preferred to lithotomy; for the present, let us suppose that a case of stone suitable for the employment of lithotrity presents itself. How are we to proceed? What are the successive steps of the operation?

It is almost unnecessary to insist on the fact that stone in the bladder is very frequently attended by more or less derangement of the genito-urinary organs, or of the general health. It is important, before proceeding to the operation, to remove these complications as far as possible; and hence what has been termed the preparatory treatment. I do not mean to say that we are to select our patients in such a manner as to operate only on those who are free from any complication. This would be impossible in hospital practice, and, moreover, would condemn many patients to per-

(Fig. 42), the rack-and-pinion instrument (Fig. 43), Charrière's last instrument, which likewise acts through a rack and pinion, but differs from the former in the shape of the handle (Fig. 44), and M. Civiale's (Figs. 45, 46).

greatest care, for they are often diseased in long-standing cases of calculus. When the symptoms are uncertain and obscure, an examination of the urine will here be of great assistance.

The state of the urethra, prostate, and bladder, must, I need hardly say, be ascertained, and above all things we must endeavour to determine whether disease of these parts has given rise to the secretion of pus. The existence of purulent deposit in the urethra, prostate, bladder, or kidneys, is one of the most unfavourable complications which can present itself, not only with respect to lithotrity, but any other operation on the genito-urinary organs. The pre-existence of such abscess is a powerful determining cause of purulent infection, and hence I would lay down the rule that every effort should be made to remove such a complication before we think of operating for stone in the bladder; and this remark applies to lithotomy just as well as to lithotrity.

As part of the local preparatory treatment, M. Civiale insists much on the propriety of introducing a soft bougie for a few days, and during a few minutes at each time, so as to accustom the urethra to the contact of a foreign body, and diminish its irritability. He never goes beyond the natural calibre of the urethra, and rejects dilatation of that canal.

Other surgeons, however, employ metallic sounds, the calibre of which is gradually increased until a certain degree of dilatation ensues; but it is much better to leave the patient as tranquil as possible until the appointed time for operating arrives. The urethra, like other parts, will bear irritation to a certain extent only, and it never can become habituated to much violence;

still, if the urethra be naturally very small, or if any stricture exists, preliminary dilatation is obviously indicated.

The next step may be considered as preparatory also, for it consists in exploring the bladder. A great deal has been said by the opponents of lithotrity, on the inutility and danger of these preliminary explorations; but they are indispensable, unless, indeed, we are content to go to work completely in the dark. They are somewhat analogous to the usual operation of sounding previous to lithotomy; the proceeding, however, is somewhat different, for more precise information is required; or, perhaps, I should rather say, that lithotritists are more careful in ascertaining every particular connected with the state of the bladder, the size of the stone, &c., than lithotomists commonly are. It should be remembered that we have to work for a considerable time with a steel instrument, on perhaps a hard body, in the interior of a small, contractile, and highly sensitive cavity. It is therefore indispensable to obtain some idea of the capacity and contractile power of the bladder before we proceed to break up a stone in this organ. A moderately-sized sound, with a small curve, (this latter circumstance is essential), is introduced into the bladder, and, being rotated, conveys a knowledge of its capacity, while the manner in which the urine escapes will enable us to form some estimate of the contractibility of the organ. Should the bladder be extremely irritable, or, on the contrary, in a state of atony, the operation must be adjourned.

Having thus ascertained that the bladder is in a condition to bear further exploration, we now continue our

examination. When the bladder is contracted the flow of urine must be prevented, and the point of the sound should be directed at once downwards towards the rectum, where the stone is most likely to be found, and the conditions of which part of the bladder, from its relation to the prostate, are most important to be known.

The most experienced surgeons have, from time to time, failed to detect the presence of a stone in the bladder by the usual method of sounding. In doubtful cases of this kind M. Civiale advises us to inject some fluid into the bladder, and to repeat the injections at short intervals, so as to vary the capacity of the organ, keeping it at one time full and the next moment empty; in this way the bladder is excited to contract, its form and capacity are made to change, and it rarely happens that, as the walls of the bladder close round the end of the instrument and the calculus, the latter is not placed in contact with the former.

Certain diseases of the prostate may cause such a depression of the bladder behind the gland, as to render it impossible to discover the stone by the ordinary method of sounding; and the same result may arise from fungous tumours, &c., at the neck of the bladder. In these difficult cases the curve of the sound must be increased, and if this fail, we must have recourse to the lithotrite, which is to be used as a sound. The small size of the calculus has always been an obstacle to its detection with the common sound. If we meet with a case of this kind, it will be necessary to inject two or three ounces of fluid; after which we may introduce the lithotrite, and on opening its blades, from time to time, the calculus is usually seized. Having seized it between

the blades of the instrument, our next endeavour is to ascertain its size; but this can be done only approximatively, for when the calculus is large, or of an oval form, it is quite impossible to measure its size with any degree of accuracy. In 1825, Retoré invented a particular instrument for the purpose of measuring the diameter of calculi (Fig. 46*a*), but all the necessary information can be ascertained by seizing the stone two or three times between the blades of the lithotrite.

Fig. 46*a*.

Fig. 46*a*.—Retoré's instrument for measuring calculi.

For practical purposes it is not necessary to ascertain the volume of the calculus within a few lines; all we want to know is, whether it be a large or a moderately sized one, and this can generally be ascertained in the manner alluded to.

A knowledge of these various points will be of great assistance to us in the operation which is subsequently to be performed. If we examine the practice of the most successful lithotritist of the present day—one who has performed more than 600 operations—we can hardly attribute his unexampled success to any other cause than the great attention he bestows on these preparatory arrangements. Some surgeons may exceed him in manual dexterity, but none bestow so much care on the medical and accessory points of each case ; and hence, I believe, the success of his practice.

CHAPTER III.

THE OPERATION.

SHOULD the explorations described in the preceding chapter have given rise to any degree of irritation, it will be more prudent to defer the operation until such irritation has subsided.

On the position of the patient a few words only need be said. The patient is placed on a bed or couch, with the pelvis slightly raised by pillows, so as to bring the most depending part of the bladder on a line with the internal orifice of the urethra. The legs are to be separated; the thighs slightly flexed; and the surgeon places himself either in front or on the right side of the patient. Having drawn off the urine with a catheter, he next proceeds to inject slowly some tepid water, continuing until the patient experiences a desire to evacute it; the quantity required generally varies from five to ten ounces. If the fluid be expelled the injection must be repeated with more caution, for we should never think of attempting to operate when the bladder is empty. In some cases the bladder, as M. Civiale observes, is thickened and extremely irritable, tending

to eject the smallest quantity of fluid introduced. Here the injection must be conducted with extreme slowness—a small quantity at a time only being thrown in—and the patient allowed to repose between each injection ; or the urine may be allowed to accumulate naturally in the bladder. If the irritability continues, we must cease our attempts for the moment, and adopt other means, as leeching, hip-baths, opiate clysters, &c. Chloroform has been tried in some cases of this kind, but without effect, the contractions of the bladder remaining undiminished, though the patient was completely insensible.

The instruments employed for injecting the bladder are a large-sized silver catheter with a stop-cock, and a metallic syringe, capable of holding half a pint, and of being accurately fitted to the catheter.

Fig. 47.

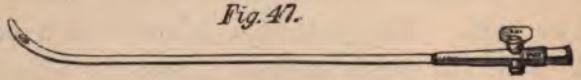


Fig. 48.

Fig. 47.—Catheter.
Fig. 48.—Syringe.

We now arrive at the introduction of the instrument. The early ones were all perfectly straight, for curved instruments were not introduced into use until 1831 or 1832. It is necessary to remember that the curve of the lithotrite differs considerably from that of

the ordinary catheter. The elbow is very abrupt, the ascending part is much shorter, and in many instruments the forceps portion is much flattened, to give solidity to the branches. In introducing the instrument the abruptness of the curve must not be forgotten; and the principal point which the operator has to attend to is to keep this curved portion constantly in the direction of the canal, especially while the instrument is passing under the arch of the pubes, and through the neck of the bladder. He must proceed with the utmost gentleness, feeling his way as he goes along. When he arrives at the bulbous portion of the urethra, the penis and handle of the instrument should be brought to a right angle with the body of the patient, by which he brings the curve of the instrument under the pubic arch. This done, he slowly depresses the handle, advancing it at the same time until the bladder is reached. The amount of depression will depend on the curve of the instrument we use; the shorter the curve, the less we need depress, but the principle to be followed is that of endeavouring to make the curve of the lithotrite follow the natural curve of the urethra.

There is seldom any difficulty in passing the instrument, at least in ordinary cases. When the prostatic portion of the urethra is healthy, the lithotrite, such as we now use, passes readily enough; but if there be any tumefaction of this gland, we must depress the handle of the instrument proportionately, so as to throw up the point and clear the obstacle. Here I must again caution the operator against using the slightest force during any of these proceedings. The young operator should never forget that it is very possible to lacerate

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the lining membrane of the urethra, and that this accident may occur without any great amount of force, especially while the instrument is traversing the membranous portion of the canal.

We have now the instrument in the bladder. The next step is to seize the stone. This is easily done when the calculus is small, and the blades of the lithotrite large. The closed instrument is first directed towards the floor of the bladder, along which the curved part is made to pass, the point being gently turned, now to one side now to another; as soon as the instrument touches one of the sides of the stone, the female branch is fixed, the male branch is slowly drawn back, and the instrument is cautiously inclined towards the calculus. Should any difficulty be experienced in seizing the stone, from depression of the floor of the bladder or other causes, then the blades are moved in a sweeping direction, with the convexity downwards, from before backwards, along the bas-fond and posterior surface of the bladder; they are then drawn back a little, and the convexity directed to the right or left side, each of which is explored in its turn; lastly, the point of the instrument is directed upwards and then downwards to the space immediately behind the prostate. The instrument should then be carefully rotated, in order to come in contact with the foreign body. This found, the blades of the lithotrite are cautiously opened, and the instrument is pressed on the stone laterally, after which the blades are closed with the same caution, every effort being made to seize the stone as much towards its centre as is possible. This is an affair of dexterity which practice and great tact alone can attain.

It is of importance to remember that the female branch should be kept perfectly immovable while we are closing the instrument, otherwise we run the risk of displacing the stone, which generally lies against its ascending portion.

Having seized the stone, the surgeon must next satisfy himself that nothing besides the stone is included between the branches of the instrument. At an early period of lithotrity, the mucous membrane of the bladder was more than once pinched up, and ground together with the stone; but such an accident, which mainly depended on the imperfect nature of the instruments then employed, is, I believe, unknown at the present day.

Fig. 49.

Fig. 49.—Stone seized by the lithotrite.

Once firmly fixed between the blades of the lithotrite, the calculus is generally broken down without any difficulty. Many surgeons employ pressure with the hand only ; and this answers well enough when the stone is not too large or hard. In other cases the use of the screw becomes necessary. Its slow propulsion soon causes the calculus to yield ; and if we employ the rack-and-pinion system, a rapid succession of slight jerks may be communicated, which produce many of the effects of percussion. Should the stone from its hardness, resist pressure, we must have recourse to percussion as an auxiliary, and Charrière's instrument admits of our employing this mode without withdrawing the lithotrite from the bladder. It is, in fact, both a a percussor and a crusher at the same time.

Before withdrawing the instrument from the bladder, it is essentially necessary to ascertain that the branches are perfectly closed, and that no detritus has accumulated in the forceps portion. If this be not done, the operator may encounter an unexpected obstacle on arriving at the urethra. A few turns of the screw backwards and forwards will usually suffice to clear the instrument, or Mr. L'Estrange's stilet may be used, if the male branch be grooved to allow of its passage.

It is only in exceptional cases, and when the stone is both small and very friable, that we can expect to break it up at a single operation. The first sitting should also be short, about five or six minutes, and when the passage becomes accustomed to the instruments, or less irritable, the operation may be prolonged for ten minutes at a time. This is a rule from which M. Civiale never deviates, and his opinion in this matter deserves the

greatest attention. From three to eight days should elapse between each operation, to allow the fragments to pass away with the urine, and any irritation which the operation may have excited to subside. Such fragments of the calculus as are too large to come away with the urine must, of course, be treated as distinct calculi, and crushed separately.

CHAPTER IV.

THE AFTER TREATMENT AND AFTER SYMPTOMS OF LITHOTRITY—OBSTACLES TO THE OPERATION.

THE reduction of the calculus into fragments does not complete all that the surgeon has to do in lithotrity. It is only a part of his work. Nearly all the consecutive accidents of lithotrity (leaving aside those which depend on improper methods of operating) are determined by the quantity of detritus which is left behind in the bladder after the first operation, and which this organ has been unable to expel. Our earliest care, then, after having broken down the calculus, is to promote the discharge of the fragments with the least possible delay.

In very favourable cases—that is to say, where the stone is small and friable, and the urinary organs healthy—the fragments will come away with the urine without any difficulty, and no interference is required. In other cases, however, we must be prepared to assist their discharge. Thus, in young subjects, the neck of the bladder is very dilatable, while the bladder itself is endowed with great expulsive power; and these two

circumstances may sometimes present themselves in the adult likewise. Now, if a considerable quantity of detritus has been produced by the first sitting, the fragments may be driven in such quantity into the urethra as to block it up, and very severe symptoms may be the result. In other cases, the retention of the detritus may depend on a certain degree of atony in the bladder; the organ does not contract with sufficient force to expel the fragments; or these latter, again, may be retained by spasmodic contraction at the neck of the bladder. In all these cases, means must be employed to favour the discharge of the detritus. A variety of instruments have been invented for this purpose ; but the simplest means are, in my opinion, the best.

If we have any reason to suppose that the detritus of the first operation will not come away readily with the urine, we should at once proceed to promote their discharge. A full-sized metallic catheter, largely fissured on its sides near the beak, is to be passed into the bladder, and the fluid which had been injected during the operation is to be drawn off. A portion of the detritus will come away with this fluid. A few ounces of tepid water are now to be injected into the bladder, and then drawn off as before ; and the injections may be repeated three or four times, until the patient complains of fatigue, or the fluid which escapes from the bladder ceases to contain any detritus.

Even during this simple operation, an accident may occur for which we must be prepared. A fragment of the calculus may become engaged in the eye of the catheter ; in such a case, on attempting to withdraw

the instrument, it is stopped near the neck of the bladder, and the patient complains of more or less pain. The surgeon's own sensations and those of his patient will here warn him to cease any attempt at withdrawing the catheter, for he may wound, if not lacerate, the narrow portions of the urethra. Our first care in an accident of this kind must be to endeavour to drive back the fragment into the bladder, by injecting some tepid water with a good deal of force into the catheter. Should this fail, a whalebone stilet may be passed down, and its point pressed against the fragment, so as to disengage it.

Some of the French surgeons have invented instruments for breaking up fragments thus engaged in the eye of the catheter; but it is difficult to understand how they can act in any other manner than by simple pressure; and if such be the case, the whalebone or metallic stilet is preferable.

If the retention of detritus depends on atony of the bladder or enlargement of the prostate, a different mode of proceeding must be adopted. We may first endeavour to excite the contractility of the organ by throwing in different quantities of fluid; and should this fail, the catheter-forceps, the scoop, or some other instrument acting on the same principle, must be introduced, and as much of the detritus removed as can be done without fatiguing the patient or irritating the bladder too much.

It need hardly be mentioned that the means now indicated are to be employed immediately after each operation, in all cases where it has been judged necessary to favour the discharge of detritus from the bladder by injection or mechanical means.

The symptoms which follow the operation of lithotrity may next be noticed; and here I allude to those which really depend on the operation that has been just performed—not those depending on the existence of a calculus in the bladder, on lesions or diseases of that organ, or on errors, &c., in the manual proceeding. The symptoms must necessarily vary with the nature of the case. In the most favourable cases I have already defined what these are — the operation can hardly be said to be followed by any symptoms at all. A single operation often suffices to crush a small friable calculus; the patient is not confined to his bed; he is well in three or four days, and the irritation arising from the introduction or use of the instruments is slight. After the operation the patient will experience for a few hours a desire to pass his water frequently, and its discharge may be accompanied with a little scalding, or be slightly impeded. These symptoms disappear on the following day. Such are the cases in which lithotrity appears under its most favourable aspect; and it might not perhaps be going too far to assert, that if calculous patients were to present themselves for treatment at a very early period of their complaint, the great majority of them might be cured in the same simple and rapid manner.

But through neglect, fear of an operation, and various other circumstances, precious time is lost; the disease gains ground, the calculus increases in size, and the urinary organs become more or less irritable. Here we suppose that the stone is somewhat larger and harder than in the most simple cases, yet that the urinary organs are still healthy, and the general state of

the patient not unfavourably affected. The first operation in cases of this kind will often excite no greater disturbance than what I have just mentioned. But we cannot be sure that things will always turn out so favourably. The operation may have been conducted with the greatest care and skill, yet the use of the instrument may cause considerable irritation of the bladder. This organ contracts violently on the fragments of stone contained in it; the pain becomes severe, sometimes excessive; in a word, the ordinary symptoms of vesical calculus are developed in an aggravated form. The passage of the detritus along the canal of the urethra is likewise more or less painful; there is frequent desire to discharge the urine, and micturition is both difficult and painful. These symptoms, which may or may not be accompanied by a certain degree of fever, generally make their appearance on the day following the first operation; they evidently depend on irritation, and gradually subside under appropriate treatment in five or six days, when the operation may be resumed.

Whenever the calculus is large, and at the same time moderately hard, the operation is necessarily longer, and the manipulations more difficult. Hence the symptoms of reaction are always more severe. The contractions of the bladder may be extremely violent in such cases; the desire to micturate very frequent; the scalding severe. Febrile symptoms often ensue, and it becomes necessary to defer the second operation for several days. Finally, in a certain number of cases, the irritability and contractile disposition of the bladder are roused, by the first operation, to such a degree, that it would be highly imprudent to continue any attempt

at crushing. The operation must be abandoned. These are rare and exceptional cases, in which the inability of the bladder to bear the introduction of an instrument, or even tepid water, can only be explained by idiosyncrasy.

The excitement of the bladder often reacts on the kidneys, and gives rise to certain symptoms connected with these organs. Their secretion is augmented by a moderate degree of irritation in the bladder, and the patient passes a considerable quantity of clear, pale urine. When the vesical irritation has been more severe, we observe an opposite effect. The secretion of urine is diminished, perhaps to such a degree as to simulate suppression; the urine is of a deep colour; the patient complains of flying pains in the region of the kidney; and sometimes febrile symptoms, attended with insomnia and great loss of strength, supervene.

Such are the symptoms which may be fairly connected with the operation of lithotrity. We can readily understand that a great variety of other symptoms may arise, should the surgeon persist in operating on a case to which lithotrity is inapplicable; but these do not depend on the operation, and will more properly be examined under the heads of accidents, obstacles, &c., to a consideration of which I now proceed.

The obstacles to the ready performance of the operation naturally come first. What are these? On what do they mainly depend? We can anticipate many of them by simply reflecting on the nature of the operation, and the conditions necessary for its successful performance. Lithotrity, in fact, is made up of the introduction of instruments of a certain size and shape

through the urethra into the bladder; of the seizing in that organ bodies of various sizes; and lastly, of working the instruments in such a manner as to break up the foreign body, and allow of its discharge through the urethra. Hence everything becomes an obstacle which impedes the introduction of the instrument, its seizing the stone, its working in the bladder. Let us follow these three divisions in their order.

For the urethra, narrowing of this canal will at once suggest itself as an obstacle. The diminution of its calibre below the required standard may depend on various circumstances. In the first place it may be natural; the urethra may be naturally so small, that the introduction of moderately-sized instruments is impossible; and this is one of the reasons why I would reject lithotrity for children.

The contraction of the urethra may be morbid; it may depend on stricture. Here we must evidently remove the obstacle before we can pass an instrument into the bladder. All slight cases of stricture are easily removed by dilatation, and even severe ones by appropriate treatment. The rule we have to observe is, not to think of operating until the urethra has so far recovered its normal calibre as to admit the introduction of the lithotrite without any difficulty. If we cannot bring the urethra into this condition, I should for my part prefer lithotomy.

The contraction of the canal, again, may depend on spasm, when it is generally removable by ordinary treatment.

The sensibility of the urethra and neck of the bladder may also oppose more or less obstacle to the introduc-

tion and working of the lithotrite. In many calculous patients these parts are excessively sensitive; the bladder, at the same time, being endowed with increased contractility. This is the same condition to which Mr. Syme has alluded in his work on stricture, and which renders the prolonged use of the bougie insupportable. Here the cause is different, but the effect the same. This morbid sensibility must be combated by appropriate means, and will often disappear. Should it continue, we have to consider whether it be connected with some organic affection of the prostate or bladder; and in such case it will be prudent to abstain from operating. If, on the other hand, the abnormal sensibility appears to be merely nervous, lithotrity is not absolutely contraindicated, according to M. Civiale's experience at least, but the operator must proceed with the utmost caution ; the operations must be short, and, after each, he must be careful to withdraw as much detritus as possible from the bladder. In cases of this kind, severe rigors, followed by accession of fever or nervous symptoms, are very apt to occur, and their appearance should be a sign not to persist in the operation. The result may be quickly fatal.

Excessive contractility of the bladder, united to the morbid sensibility just described, presents another obstacle, which it is often very difficult to overcome. Here the proper working of the instrument in the bladder becomes impossible; the fluid—even one or two ounces—which we inject, is immediately expelled; and, in such case, it is far better to give up all thoughts of crushing the stone than run the risk of exciting fatal symptoms, by operating in an empty and disordered organ.

Enlargement of the prostate not only impedes the easy introduction of the instrument, but its working in the bladder ; this we can readily understand, since the same cause is an impediment to the introduction of the catheter. Still we are not to conclude that every degree of prostatic enlargement presents an insuperable obstacle. If this were the case, numerous patients would be deprived of the benefit of lithotrity. Experience has abundantly proved that slight enlargement of the prostate is no contra-indication to the employment of lithotrity. On introducing the instrument some difficulty may be at first experienced, and this must have been great at an early period of lithotrity, when straight instruments only were employed. But the curved lithotrite can generally be introduced, by taking care not to depress the handle too much when the point of the instrument arrives under the arch of the pubes.

On the other hand, any considerable enlargement of the prostate, especially of its middle lobe, which may project backwards into the bladder, must necessarily diminish the cavity of this organ, and therefore impede the free working of the instrument, on which the success of the operation so much depends.

In cases of this kind it would be highly improper to have recourse to the operation without having first ascertained, by careful examination, the degree and nature of the obstacle the surgeon has to contend with. The swelling of the prostate, moreover, has a tendency to deepen the depending part of the bladder behind it, in which the calculus usually lodges ; the blades of the lithotrite cannot be opened freely, the movement of rotation downwards is impeded, and the stone cannot

be readily seized. All these points must be taken into consideration ; and hence we may conclude, that it is better to abandon the idea of crushing in all cases where the enlargement of the prostate is of such a nature as to render it probable that the operation may be either long or attended with any considerable difficulty. The same observation will apply to fungoid and other tumours of the neck of the bladder or prostate.

Another obstacle, very analogous in its seat and effects to enlargement of the middle lobe of the prostate, arises from the presence of the structure, which Mr. Guthrie has well described under the name of "the bar of the neck of the bladder."

Fig. 50.

Fig. 50.—Bar-like ridge at the neck of the bladder. The points of the probe show the orifices of the ureters.

This obstruction is generally observed in old persons who have laboured for a considerable time under vesical calculus. It is formed by hypertrophy of the submucous cellular tissue, which rises up like a bar and stretches across the neck of the bladder just behind the middle lobe of the prostate. In some cases the bar contains also a few fibres of hypertrophied muscular tissue. It usually runs horizontally across the neck of

the bladder, or its direction may be a little oblique. The length of the bar varies from one to two inches, and it may rise to a height of half an inch, being sometimes a quarter of an inch in thickness.

The existence of such a barrier as the one now alluded to, must evidently impede the introduction and working of lithotritic instruments in proportion to the extent of the mechanical obstacle. It is also frequently accompanied by hypertrophy of the gland, and the embarrassment of the operator is then increased twofold.

The lithotrite passes down easily to the neck of the bladder, but there it is suddenly brought up by the dam-like ridge. Hence when the nature of the obstacle has been recognised, the operator must suddenly tilt up the point of the instrument, when he arrives at the impediment, and endeavour to pass over it. He will often succeed in doing this when the bar does not exceed two or three lines in height. When the instrument has been passed into the bladder it can usually be worked without any great difficulty. The movements, however, must give rise to more or less friction against the surface of the ridge, and hence considerable pain, often followed by severe reaction. The presence of this bar-like ridge must likewise prevent the free discharge of detritus, and promote the development of the numerous accidents which may accompany retention of fragments in the bladder.

The condition of the bladder itself may also present certain obstacles which must be taken into account. In many old cases of stone the bladder is hypertrophied, the muscular fibres become abnormally developed and

strong, while, from the long-continuance of the disease, the organ is excessively irritable. The contact of instruments here produces great pain, and excites violent contractions. A moderate quantity of fluid is instantly expelled from the bladder. There is no room, in fact, to manipulate freely in the contracted cavity, and there is much reason to fear that any prolonged attempts may give rise to dangerous symptoms. Here, unless the stone happens to be small and very friable, leading us to conclude that the operation will be terminated in a short time, it is more prudent to abstain from lithotrity. This decision, indeed, is strengthened by other considerations; but these will be noticed when I come to speak of indications.

Another condition of the bladder which presents an insurmountable obstacle to the performance of lithotrity, is that well known under the term "sacculated." Here an accidental cavity is produced by the mucous membrane, which forms a kind of hernial sac through the muscular fibres; and when the calculus becomes engaged in one of these sacs it is said to be encysted. For such unfortunate cases the art of surgery is without resource. They are equally incurable by lithotomy. I suppose, of course, that the calculus is firmly impacted in the sac, and does not leave it; for in some cases the stone passes from time to time into the bladder, and then lithotrity may be employed with advantage.

The size and consistency of the stone are the last points to be noticed. A very large stone nearly filling the bladder cannot be seized by any instrument, and in such a case lithotrity is evidently out of the question; for one of its requisites is, that the calculus should be

seized and firmly grasped between the blades of the lithotrite. Considerable size of the stone, therefore, is always an obstacle; but here I would remark, that even large calculi present, *cæteris paribus*, no great difficulty, provided they can be seized, and are at the same time friable. Phosphatic calculi often unite these two conditions.

It is difficult to lay down any absolute rule as to the exact size of the calculus which renders the operation inadvisable—that is to say, when we come to the limit which appears to separate the possible from the impossible. Calculi from two to three inches in diameter have been broken up or crushed, but the operation is often long, painful, and difficult; and it might perhaps, be laid down as a prudent rule, that we should abstain from operating whenever the calculus exceeds in diameter two inches, and is at the same time hard. As for calculi which are both hard and of very large size, they present obstacles that cannot be overcome without great risk of life, and are therefore by universal consent reserved for lithotomy.

Excessive hardness of the stone (and many mulberry calculi are of this kind) causes an impediment to breaking up the calculus in a moderate time, and is therefore a reason why lithotrity should not be had recourse to under such circumstances. Even when the calculus is only moderately hard, I would hesitate to undertake the operation if the bladder were at the same time irritable, or any organic lesion existed which was calculated to prolong the necessary manipulations.

In reference to this part of the subject, I may mention a curious circumstance, which is fortunately rare,

but which, if it did present itself, might cause no small embarrassment to the surgeon. A patient may have a stone in the bladder without being affected by urinary calculus.

A case of this kind came under my observation very lately. I was sent for by a medical practitioner to remove a calculus from the bladder of a young female patient. The foreign body was not large, and we therefore agreed that it should be removed by dilating the urethra. This was speedily done, and the stone extracted in a few minutes. On examining it we found, to our great surprise, that it was a real stone—a flat flint pebble—quite free from any trace of calcareous incrustation, and therefore recently introduced into the bladder. It was so hard that no lithotriptic instrument could have made any impresssion on it, and had the foreign body been of such a size as to have induced the surgeon to attempt lithotrity, he might have been much puzzled to account for its extraordinary hardness.

At an early period of lithotrity, when the straight three-bladed perforator was the only instrument employed, the form of the calculus sometimes presented a very great obstacle to seizing it with facility. This does not occur now. The curved lithotrite easily seizes flat calculi; and unless they are very hard, the action of the screw or pinion crushes them with equal facility.

CHAPTER V.

THE ACCIDENTS OF LITHOTRITY.

THE accidents which sometimes supervene on the operation of lithotrity are, if we believe some surgeons, severe and numerous. Professor Velpeau, in his work on Operative Surgery, enumerates no less than twenty-nine ; but this is a great exaggeration.

By far the most frequent accident to which patients who have undergone lithotrity are liable, is the lodgment of the calculous fragments in the canal of the urethra. A distinguished operator asserts that it occurs about once in four times. The younger the patient, the more likely is he to suffer from this complication, and for two reasons : the neck of the bladder is very dilatable in the young subject, and hence may give passage to fragments which are too large to traverse the other portions of the canal ; and again, the bladder in young persons contracts with a considerable degree of energy, whereby the detritus, even when fine, is apt to be driven in large quantities through its neck, and accumulate in the urethra, which it blocks up more or less completely.

The same accident often occurs in the adult ; and

the symptoms to which it may give rise, if neglected are of a very severe nature. The foreign body produces inflammation and ulceration of the canal, followed by effusion of urine, &c., irritative fever, and perhaps death. This latter event has occurred more than once in the early period of lithotrity—surgeons, experienced in other respects, never having thought of ascertaining whether a fragment of stone was arrested in the urethra, and the cause of the patient's suffering remaining completely unknown until after death.

The fragment may be stopped at any part of the urethra, but the commonest seats are the neck of the bladder, the membranous portion, the middle of the spongy portion, and the fossa navicularis. Contraction existing at any part of the canal, whether spasmodic, or of a more permanent nature, will favour the detention of detritus ; and we may expect the accident to occur whenever the urethra is very irritable, the contractile power of the bladder great, and the quantity of detritus resulting from the first operation considerable. These three conditions are evidently the most favourable to the development of the accident, for we have a large mass of matter acted on by a strong propelling force and an excessive contractility of the canal through which the matter or detritus is to be driven.

The symptoms arising from impaction of a fragment in the urethra are various. A fragment of any size, particularly if it be hard and rough, soon produces more or less sensation of uneasiness in the part, and this quickly passes into pain. The patient suddenly discovers that he is unable to pass his water as freely as before, or he may have complete retention ; at all

events, micturition is difficult and painful, while the desire to pass water is frequent and urgent. Should the obstacle escape the notice of the surgeon—an error now very unlikely to occur—or should immediate relief be not afforded, general symptoms soon set in ; and it is a remarkable fact, that these are very often totally disproportioned, speaking theoretically at least, to the local cause from which they arise. It would be difficult to imagine, *à priori*, that a small fragment of stone in the urethra could produce the severe and dangerous constitutional disturbance which it often does. The patient becomes nervous and irritable, he is unable to sleep, irritative fever may ensue, preceded or accompanied by severe rigors, &c. ; and if the bladder becomes irritable at the same time, from retention of detritus, the case may terminate fatally. A highly interesting and instructive case of this kind occurred some time ago in the practice of Mr. Fergusson, at the King's College Hospital. The impaction of fragments in the urethra, in this case, caused excessive local pain, followed by a high state of constitutional irritation. The fragments were removed with the urethra-forceps, or broken up ; but the accident recurred ; the urethra became inflamed ; the inflammation extended to the bladder, ureters, and kidneys ; an abscess formed in the groin, and the patient sank, in a deplorable state, after three weeks' suffering. This case, and many others of a similar kind on record, show that too much attention cannot be bestowed on the accident to which I now allude. It requires prompt and effectual means for its relief.

As soon as we have any reason to suspect its existence, a sound should be passed into the urethra, to ascer-

tain the nature and seat of the fragment; for the remedial means differ somewhat according as the fragment may have become impacted in the anterior, the membranous, or the vesical portions of the urethra. A large metallic sound may be used at first; but if the surgeon fails to meet the foreign body with this instrument, the symptoms continuing all the while, a large-sized soft bougie is to be passed down the urethra, for it is possible that the fragment may be lodged in one of the lacunæ. If this be the case, the edge of the fragment, as M. Civiale observes, seldom fails to leave a mark on the bougie, whereas a metal sound might pass over it without any sensation being communicated. Having ascertained the seat of the fragment, our next care, of course, is to remove it without delay. For this several means have been proposed, and each may be employed with success according to circumstances. The fragments may either be pushed back into the bladder, extracted whole, broken up in the urethra, or removed by external incision. But prevention is better than cure; and I shall therefore now briefly notice the precautions which M. Civiale's great experience has suggested for the prevention of the accident.

The surgeon can, generally speaking, form a pretty correct idea of the cases in which impaction is most likely to occur, and in such cases he should employ certain precautionary measures. Thus, let us suppose that the neck of the bladder and membranous portion of the urethra are very irritable, and at the same time dilatable; that the bladder is capable of contracting with considerable force; that the first operation has given rise to a good deal of detritus. In such cases we may appre-

hend impaction of the fragments, and should take our measures accordingly. The patient should not be allowed to make water while on his knees, but must endeavour to do so while on his back. Immediately after the operation, several injections of tepid water should be thrown into the bladder by means of a large catheter, with large eyes, and this for the purpose of removing as much detritus as possible. If the bladder be very irritable and contractile, it is necessary, as soon as the first operation has terminated, to introduce a large flexible sound into the bladder, and leave it there. The canal of the urethra is thus filled, and the passage of the detritus prevented; but in some unfavourable cases the patient is unable to bear any instrument permanently, and hence, if it causes too much irritation, it must be withdrawn.

When operative proceeding becomes necessary, it may be directed to the object of pushing back, extracting, or breaking up the fragment. If the latter be impacted in the neck of the bladder, or behind the triangular ligament, we should, in the first instance, make an attempt to push it back into the bladder. If the fragment be small, and seated near the neck, this can be easily done with the sound or bougie. Should any resistance be experienced, it will be well to try the effect of injecting tepid water with some force, while pressure with the catheter is exercised at the same time. M. Civiale speaks highly of this as an auxiliary means, and it should never be neglected. On making pressure with the catheter, great care must be taken that the instrument does not pass forwards between the wall of the urethra and the foreign body, or even make a false passage,

which might readily occur if too much force were employed with a metallic instrument of small calibre. In all operations on calculous patients, the surgeon cannot too strongly bear in mind that the mildest means are the best, provided they be efficacious. The genito-urinary organs are seldom in a state of perfect health; they take on irritation or inflammation most readily, and this latter may within a few hours convert a favourable case into one of hopeless danger.

Should we find it impossible to push back the fragment from the membranous portion of the urethra, where impaction very often takes place, we have only the choice between extraction or crushing. Whenever the former can be effected without much difficulty, it is to be preferred. Sometimes a blunt hook has been employed, sometimes forceps of various kinds, called "urethral forceps." From the dilatable nature of the membranous part of the urethra, some writers affirm that fragments seated there may be often broken up without any great difficulty.

We are advised to crush them between the blades of

Fig. 50 a. *Fig. 50 b.*

M. Civiale's Urethral Lithoclast.

Fig. 50 a.—Shows the instrument open.
Fig. 50 b.—Shows the instrument closed.

a strong forceps, or employ small lithoclasts with flattish short blades, such as the one represented in the drawing. If we can succeed in seizing the fragment with this instrument, it is easily crushed ; but extreme care must be taken not to pinch the walls of the urethra between its blades. It must also be borne in mind that the manipulation of instruments in the urethra is a more delicate and painful proceeding than that of crushing a stone in the bladder. The vital tissues are in close contact with the forceps or lithotrite, and every movement produces more or less pain. Although recommended on high authority, the expediency of crushing fragments seated far back in the urethra, seems to me very doubtful.

The fragment, again, may be impacted, not in the membranous portion of the urethra, but at some point anterior to it, between the glans and bulb. It was formerly the practice to treat all cases of this kind by external incision, and if every other means fail, we must have recourse to the knife ; but in modern practice such a necessity does not often occur, in connexion with lithotrity at least. However, if the fragment were large, the patient irritable, and any difficulty in seizing the foreign body presented itself, I should prefer cutting into the urethra to the risk of lacerating the corpus spongiosum by any degree of force. The number of instruments invented for the purpose of extracting fragments from the straight portion of the urethra is immense, and their multiplicity shows that no satisfactory one has yet been discovered. The fragments may be extracted or crushed, as in the former case ; the straight two-bladed forceps with elastic branches, contained in a sheath, may be employed for extraction ; or, when the

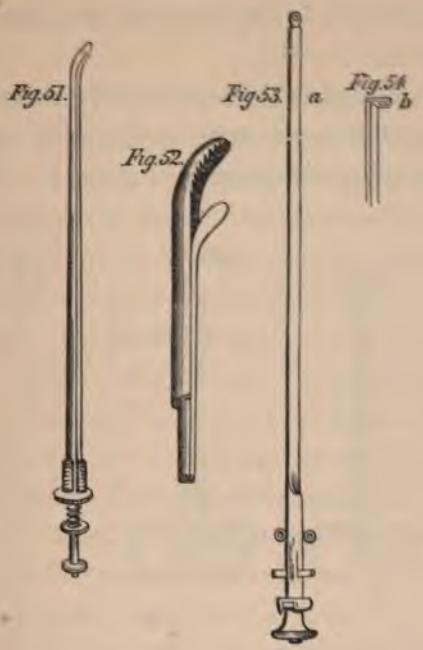
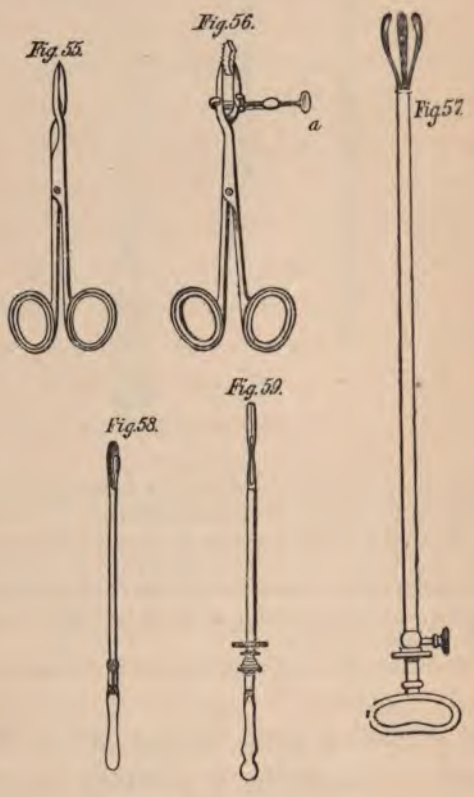


Fig. 51.—M. Civiale's lithoclast for fragments in the straight part of the urethra.
Fig. 52.—Shows the extremity of the instrument open.
Fig. 53.—M. Leroy d'Etiolles' instrument for the extraction of fragments from the urethra. It is a flat canula, having at the end a small scoop, hollowed like an earpick, and is capable of being bent to a right angle by means of a hinge and stilet, which traverses the canula. *a*, shows the end of the instrument as it is introduced behind the fragment.
Fig. 54.—*b*, the end now bent to a right angle, so as to embrace the fragment.

fragment is small, a blunt hook, a probe, &c., may be used; and the operation is generally the more easy, since the penis can be grasped behind the fragment, so as to prevents its displacement, while an assistant draws the organ forwards. In this way, the blades of any well constructed forceps can generally be passed on either side of the fragment without much difficulty, or it may be crushed *in situ* with an urethral lithoclast, the

male blade of which is much shorter than the female one, as is seen in the drawing.

Finally, a considerable fragment of the calculus may become impacted in the fossa navicularis, and produce retention of urine and detritus behind it. If the frag-



Figs. 55, 56.—M. Leroy d'Etiolles' forceps for the extraction of fragments; when the latter are too large to pass readily through the fossa navicularis, they are crushed by the hook and screw, Fig. 56, *a*, attached to the blades.

Fig 57.—Hunter's urethral forceps modified. (This improvement of the three blades was made by Sir W. Blizard.)

Figs. 58, 59.—Weiss's instruments for the extraction of calculi from the urethra. Fig. 58 shows an instrument open; Fig. 59 an instrument closed.

ment can be seized, it should be crushed by the forceps.

From the situation of the fragment, so close to the external orifice of the urethra, we might imagine that it should be extracted with hardly any difficulty. But this is not always the case. The fragment is sometimes too firmly impacted to be removed with the forceps, or even seized between the blades of any instrument; and in such cases it becomes necessary to divide the external meatus slightly, with an instrument similar to that used for the internal division of stricture. When the various means, now described, have failed, nothing remains but to cut down on the fragment through the urethra, and extract it. I shall describe this operation under the head of urethral lithotomy.

In examining the accidents of lithotrity, an important distinction is to be made: many of the accidents attributed to the operation do not essentially belong to it; and in estimating the value or applicability of any new operation, we must be careful to distinguish those accidents, which may be fairly connected with the proceeding, from such as depend on causes that are foreign to it—want of skill in the operator, imperfection of instruments, &c.; some, in short, are *real*, while others are *presumed*.

Keeping this distinction in mind, let us now consider the principal accidents which may complicate an operation of lithotrity, beginning with those denominated *presumed*—that is to say, which are not necessarily connected with the operation, but depend rather on the operator, his instruments, and defective modes of proceeding; and, above all, on perseverance with the ope-

ration in cases for which it is manifestly unsuited. In scientifically discussing the merits or demerits of any surgical operation, we have no right to lay all that may occur to the door of the operation. One of our museums contains the trachea of an unfortunate patient, with a large molar tooth sticking in it, which a bungling dentist allowed to drop into the larynx while performing the operation of extraction; yet who would think of saddling the operation with the result of such an untoward event? It is the same for many of the objections made to lithotrity.

Thus, it is said the urethra and neck of the bladder may be lacerated, either during the introduction or withdrawal of the instruments. Such an accident has undoubtedly occurred, and more than once, at an early period of lithotrity; but we may fairly deny that it is necessarily connected with the operation. The size of the curved lithotrite now employed does not exceed that of a large catheter, and, when properly introduced, the manipulation is seldom more difficult than the common operation of passing an instrument to draw off the urine. If a surgeon were to lacerate the urethra or neck of the bladder while passing a catheter to empty this organ, we would not surely attribute the accident to the operation, but to the operator.

In certain cases, indeed, where the prostate is much enlarged, where tumours block up the neck of the bladder, &c., violence may be committed; it may be impossible to avoid inflicting a certain amount of injury on the canal: but here, again, I would ask, should we not rather attribute any accidents which occur to the injudicious attempt at applying lithotrity

to a case for which it is not suited? If an attempt be made to force a small stricture with a metallic sound, the walls of the urethra may be easily lacerated; but is this an argument against methodical dilatation, practised according to the rules of our art? Are we to reason from what *may* occur to what *should* occur?

As for laceration or injury inflicted during the withdrawal of the instrument, they can occur under two circumstances only. If the urethra and neck of the bladder have admitted the lithotrite, they should also allow of its extraction, unless the instrument has been bent in the bladder; and this may arise in two ways: the instrument bends or breaks, or its branches, beyond the curve may be more or less separated from each other by the detritus engaged in the dentated and concave portions. Should this separation take place to any degree, and the operator persist in withdrawing the unclosed blades with force, he must inevitably lacerate the neck of the bladder or a narrow portion of the urethra. Here again I may ask, does not the accident depend on neglect of the rules which experience—I might even say common sense—have established? The operator should never think of withdrawing the lithotrite without examining the scale to see whether there is any separation of the blades, from detritus or any other cause. In such case no attempt at withdrawing the instrument is to be made until the detritus has been removed. If, as has occurred in many unfortunate cases, the surgeon endeavours to force an instrument through the canal, well knowing at the time, or at all events having it in his power to know, that the instru-

ment is too large to traverse the urethra, is it the fault of lithotrity if he lacerate this canal?

The instruments may break in the bladder, or they may bend and warp, their extraction then producing formidable injury or even fatal results. This objection was much insisted on many years ago, yet at the present day it appears so futile that one is almost ashamed to discuss it. Are the faults of the cutler to be saddled on the surgeon or on surgery? Does imperfection of the instrument necessarily imply imperfection of the art? Our forefathers employed wooden cannon, which of course often burst and destroyed more friends than foes, but this proved nothing against the efficiency of gunpowder as a propeller of balls. To have any value, it should be shown that the amount of force necessary for crushing calculi is of such a degree as to render it probable that the instruments employed must either yield or break. It were useless for me to discuss the causes which formerly led to the accident I now consider. It was partly the fault of the instrument, partly of the surgeon; it is, I believe, almost unknown at the present day; it never occurred in the hands of the surgeon to whom we are indebted for lithotrity, and who has performed nearly 600 operations without ever having had to deplore so unfortunate an accident. To guard against it, as far as possible, the surgeon should never think of operating on the living body without having previously assured himself, by experiments on hard substances, that his instruments are well made, well tempered, and capable of supporting the amount of pressure which they are intended to exercise; and should the accident

occur, he must be prepared to cut into the bladder, and either extract the fragment, or restore the bent instrument in the best manner he is able.

The mucous membrane of the bladder may be pinched up between the blades of the instrument, or lacerated and the bladder itself has been perforated. In ordinary cases it is difficult to understand how such accidents can occur with the instruments now employed. The bladder is more liable to be pinched when the calculus is very small, when the bladder is columnar, or while the surgeon is endeavouring to seize the fragments of a stone already comminuted. The accident will also be favoured by the practice sometimes employed, of allowing the injection to escape suddenly from the bladder, in order to induce this body to contract, and bring the calculus within the grasp of the instrument. This is a faulty method, adopted to supply want of dexterity. With the flat broad crusher the surgeon will generally be able to avoid including the walls of the bladder within the blades; but if such an accident did arrive, his own sensation of a soft body, and the feelings of the patient, would, I think, give him sufficient warning to desist in time.

CHAPTER VI.

ACCIDENTS OF LITHOTRITY.

In addition to the presumed accidents of lithotrity, there are others which evidently depend on the operation itself, and may therefore be fairly attributed to it, while some are of a doubtful nature, and may possibly belong to both categories—that is to say, may partly depend on the nature of the operation, and partly on causes extraneous to it.

It is easy to anticipate some of the accidents and complications necessarily connected with an operation of lithotrity. The urethra, for example, may be lacerated. This I have not hesitated attributing either to the surgeon or to defective instruments; but, although this amount of injury may not be inflicted, it is almost impossible to introduce lithotritic instruments through the urethra, and manipulate them in the bladder for a few minutes, without exciting more or less painful sensations. Pain may be excited during the introduction of the instrument; while the stone is being crushed; during the withdrawal of the instrument; or, lastly, may come on some time after the first operation. It is necessary

to note the time at which pain is experienced, for many indications may be deduced from this circumstance.

When lithotrity was in its infancy, the most contradictory statements prevailed relative to the amount of suffering which the operation necessarily entailed. Its advocates gave a highly coloured picture of the operation, which some described as perfectly painless; while its enemies—and they were both numerous and powerful—described the operation as one generally attended with the most horrible sufferings. Time has done justice to exaggeration on both sides, and we are now in a condition to arrive at the truth.

The operation of lithotrity always produces more or less pain and uneasy sensations; but when the operation is properly conducted, and the patient in a favourable condition, the amount of pain is so trifling that it need hardly be taken into account. Under such circumstances, the passage of the lithotrite along the canal of the urethra does not give more pain than the introduction of a full-sized catheter. When the instrument passes under the arch of the pubes, some dragging pain is generally produced, because it requires some dexterity to adapt the curve of the instrument to the curve of the urethra; but this lasts for a second or two only.

The contact of the instrument with the walls of the bladder gives rise to much less pain than we might *à priori* conclude. The bladder, when in a healthy state, is not very sensitive; besides it must be remembered that the instrument does not work in an empty bladder, but in one where the calculus is surrounded with fluid;

and if the operator cannot attain this latter condition of isolating the stone, he had better give up the notion of attempting to crush it.

In the bladder, then, the sensations are seldom acute : the patient feels some uneasiness, followed by a strong desire to expel the contents of his bladder, but nothing more. In a few hours after the first operation, the urinary organs have recovered their usual state; and it often happens that the patient requires no assistance to walk from the place of operation to his own abode. It is not pretended that all cases will present this favourable condition, which characterises those only that are of a simple nature. In more difficult cases, it is impossible to avoid inflicting a certain amount of pain; but when the operation has been restricted within its proper limits, and due precautions are used, the pain is always of a nature to be readily borne by the patient. Should it be excessive, the accident will probably depend on some error connected with our method of operating, or on the circumstance that the case is not suited for lithotrity. Any violence or jerking movements must increase the amount of pain inherent to the operation ; and still more so, the custom formerly prevalent of prolonging the operations beyond five or six minutes. We can readily understand, that if a surgeon treats the bladder as he would a mortar, and proceeds to grind down a calculus as he would a lump of rhubarb, the living tissues must soon experience the effect of his inconsiderate manipulations ; but it is now presumed that the operation, in all points, has been scientifically conducted ; and when this is the case, the pain is either insignificant, or of a very endurable kind, in the great majority of

instances at least. The contrary, however, occasionally happens. The bladder and urinary organs may be apparently healthy; the calculus small; every precaution has been employed, yet the neck of the bladder is excessively irritable. Here the passage of an instrument over the morbidly sensitive parts excites excessive pain; and if the operation be persevered in, violent and dangerous constitutional disturbance may ensue.

Many cases of lithotrity are on record, in which the pain is described as having been of the most violent kind, and its effects of a disastrous nature; but, on examining them with attention, we shall generally find that the calculus was large and hard, the operations being proportionately prolonged; that the prostate or bladder was diseased, and the latter organ excessively irritable; that fungous or other tumours diminished its cavity, and therefore impeded the free play of the instruments, &c. The infliction of pain and injury is inevitable under such circumstances, but it should be attributed, not to the operation, but to its improper application. The pain occasioned during the withdrawal of the lithotrite, and from the passage or impaction of the fragments in the urethra has been already noticed; and the pain which comes on at a certain interval after the first operation evidently depends on some lesion of the genito-urinary organs.

This perhaps might be the proper place to notice the applicability of chloroform to lithotrity, but various considerations induce me not to advocate the use of anæsthetics in that operation.

The same cause which produced pain may likewise

give rise to more or less discharge of blood from the mucous surfaces of the urethra and bladder. This very rarely attains a degree sufficient to deserve the name of hæmorrhage.

Every practitioner is aware that the passage of a common sound in cases of stricture is often followed by some discharge of blood, and the same effect may follow any slight abrasion of the urethral surface caused by the passage of the lithotrite. The surface of the bladder, particularly in old patients, may likewise furnish a small quantity of blood from abrasion; or the capillary vessels in the neighbourhood of the neck of the bladder may be the seat of the discharge, and this appears to be the case most commonly; but in all these cases the hæmorrhage is slight, and soon ceases of its own accord. I presume of course, that no severe injury has been inflicted on the urethræ or bladder by the operator, or that no complications exist to which the hæmorrhage can be attributed. Bleeding to any considerable amount has never occurred in the long and extensive practice of M. Civiale, and he considers that the accident, when it does occur, should be set down to the account of the operator, or to the neglect of those rules which experience has sanctioned. Still several cases of severe and even fatal hæmorrhage are on record. A patient, operated on at the Hôtel Dieu, in 1832, died of hæmorrhage from the bladder; and Mr. Key relates a case where the bleeding was so violent as to render necessary an immediate recourse to lithotomy. It is not easy to account for such unfortunate accidents, unless we admit the infliction of some injury, or the presence of fungous tumours, &c., in the

bladder; it is difficult to understand how anything like serious hæmorrhage can occur during an operation which has been properly performed.

In a few cases the discharge of blood takes place at a certain interval after the operation, and not during its performance. M. Civiale attributes the hæmorrhage, under such circumstances, to over-distension of the bladder with urine, or to the violent efforts which the patient has made to expel the contents of the bladder during the operation. The mucous membrane of the bladder is congested, and any strong action of the subjacent muscular tissues will easily give rise to an exudation of blood, just as we find takes place in cases of sore throat. To arrest the bleeding in cases of this kind, the urine should be drawn off frequently, or an instrument be allowed to remain permanently in the bladder. By keeping this organ in a state of perfect repose, we avoid the bleeding which has been occasioned by its inordinate action.

Although the hæmorrhage now spoken of seldom occurs to a troublesome, much less dangerous, extent, it may influence the results of an operation in two ways. The blood coagulates in the bladder, the fragments of the calculus become enveloped in the clots, and the surgeon experiences some difficulty in completely clearing out the bladder; the injection of tepid water will, in such cases, facilitate the evacuation of the coagula; or the latter may be of such size as to cause temporary retention of urine—a very distressing accident.

The surgeon who undertakes lithotrity should never for an instant lose sight of the condition of the bladder, either immediately after the first operation, during the

intervals between each operation, or during the whole course of the treatment, for retention of urine may supervene at any of those periods, and if this be overlooked or neglected, the results may be rapidly fatal.

Those who have had frequent opportunities of performing lithotrity cannot fail to have remarked that, while the use of the instruments almost invariably determines an urgent desire to empty the bladder, no sooner is the operation over than this desire ceases in a great many cases, and is replaced by the contrary condition, a sluggishness of the organ, which may be carried so far as to produce complete retention of urine. Hence a practical rule which we should never neglect, that our first care after each operation should be to determine whether the bladder is able to expel the fluid contained in it. Sometimes the cause of retention is so slight, that a warm bath is sufficient to dispel it; but in all cases it is of course our duty to ascertain in the first place what the cause may be. I have already spoken of coagula in the bladder and the impaction of fragments in the urethra. These are mechanical causes; but in the great majority of cases, the cause is physiological. Sometimes it may be traced to a spasmodic condition of the urinary passages, sometimes to atony or paralysis of the bladder, and very often to a combination of the two.

In elderly patients, particularly when the prostate is somewhat enlarged, the neck of the bladder is often the seat of spasmodic contraction, which may extend even along the whole course of the urethra. This spasmodic tendency may exist previous to lithotrity, or it may be developed by the introduction and working of instru-

ments, especially when the operations have been too long, and irritation of the urinary passages has been the consequence, the warm bath, followed by a full dose of opium, often removes the condition of which I now speak; but it will be more prudent to draw off the urine with a catheter as soon as any difficulty of emptying the bladder occurs.

The retention of urine which ensues on partial paralysis or atony of the bladder is a much more serious affair, not only from the nature of the cause, but from the insidious character of the affection, which may be readily overlooked. This atonic condition is often connected with sub-acute inflammation of the bladder, and any long retention of the urine may have the most disastrous effects. Hence the urine must be drawn off as often as it accumulates; it is not advisable to leave a catheter permanently in the bladder, for fear of increasing any latent inflammation which may exist already. This subject will be noticed again when treating of indications.

In a few rare cases the operation has given rise to suppression of urine, and all the consequences attendant on that fatal accident. It is one which few writers on lithotrity have noticed; but a case which occurred in my own practice, not long ago, demonstrated the connexion between the operation and the accident in a very remarkable manner. The case did not appear unfavourable for lithotrity, and the operation was easily performed; but towards evening the man got drowsy, and soon fell into a comatose state, attended by suppression of urine, which proved fatal on the third day. The kidneys were found to have been inflamed, and

were quite pulpy, yet no symptom of renal disease had presented itself during life.

Pain, hæmorrhage, suppression and retention of urine are the chief local accidents which arise from the operation of lithotrity. The constitutional accidents may be comprised under rigors, febrile attacks, and nervous disturbance.

The rigors and febrile attacks have been generally attributed to some peculiar susceptibility of the patient; but this is merely a way of turning the difficulty without solving it, or leading to any practical indication. They are not proportionate to the amount of pain experienced during the operation, but they are more frequent and severe after the first than the subsequent operations. Experience, likewise, proves that both rigors and fever are much more apt to come on in a severe form when the operations have been prolonged; and hence another argument for not continuing to fatigue or excite the urinary organs by prolonging the manipulations beyond a certain time.

The febrile symptoms arising from impaction of fragments in the urethra have been noticed before, and the peculiar form of fever, preceded by intense rigors, and often mistaken for intermittent fever, which depends on purulent infection of the blood from abscess or phlebitis, will be fully described in another part of this work.

The manipulations necessary for breaking up a calculus in the bladder may excite inflammation of this organ. It were useless to deny this fact, and it would be culpable to endeavour to underrate its importance. Cystitis may be a result of the operation, and acute inflammation of the bladder occurring in con-

junction with stone is generally fatal; while, on the other hand, chronic cystitis is an obstinate disease, when once established, reducing the patient to a state of constant distress and suffering. It is, then, a point of the highest importance to determine how far the operation of lithotrity is, *per se*, calculated to develope the accident of which we now speak. This is a very difficult subject, and it would require considerable discussion to examine both sides of the question in a complete manner. It would be necessary to distinguish the secondary effects of the presence of stone in the bladder from those produced by the operative proceeding; to determine how far any inflammation excited may have been the result of the operation in itself, or of the operation performed on parts already diseased—it would be necessary for us to examine whether the previous condition of the urinary organs was not such as to exclude all notion of operating—whether the manipulations were conducted with sufficient care, and the operations not prolonged beyond a reasonable period. These and many other points of the same kind would lead me so far that I must content myself with stating what I believe to be the results of experience in this matter.

In the first place the internal surface of the bladder is far from possessing the degree of sensibility which we might, *à priori*, attribute to it. Unless roughly handled, or previously diseased, it will bear the necessary amount of manipulating without injury.

In the next place, experience demonstrates that when the case has been properly selected, according to the indications to be presently explained, and when the

operation has been properly performed, acute cystitis is of very rare occurrence. The reverse may be expected to occur, and, unfortunately, has often taken place, when surgeons have persevered in attempts to destroy large calculi in diseased bladders; when experiments have been made with new-fashioned instruments of imperfect construction; when disease of the prostate has occasioned protracted proceedings; when paralysis of the bladder, or irritable bladder with some obstruction at the neck, has given rise to neglected retention of urine. In these and similar cases, cystitis has set in, and rapidly proved fatal. Whether the accident was inevitable or not, I cannot now examine; but, I can affirm that acute cystitis occurs in a small proportion only of properly selected cases.

Peritonitis may also set in after lithotrity; this accident is still more rare than cystitis, nor can we understand how it should occur without the infliction of some severe injury on the bladder. It has followed perforation of this organ, either with the instrument or a sharp fragment of the calculus during efforts at extraction; it has also arisen as a consequence of the extension of inflammation from the bladder to its peritonæal coat. The remarks which I have just offered relative to cystitis, render it unnecessary to say anything more on this complication.

Cystitis and peritonitis occur much more frequently in the practice of some operators than of others. This we discover at once from the history of the various cases which have been published; and it leads to the conclusion that such accidents rather depend on the application of lithotrity to cases unsuited to the opera-

tion than to any fault inherent in the operation itself. If the surgeon, as was formerly too often the case, will persevere in endeavouring to break up a calculus in a contracted, irritable, and diseased bladder, for half an hour or an hour at a time, can we wonder that acute or chronic cystitis is the result? We should, indeed, rather be astonished that the accident is not developed more frequently.

In a certain number of cases, even when every indication has been strictly fulfilled, the operation of lithotrity has excited nervous symptoms of more or less severity; and sometimes also produced very great derangement of the digestive organs. The nervous disturbance has been attributed to the shock inflicted on the economy. It is similar to that which occasionally results from introducing a catheter or bougie, and is seen, though in a much more aggravated form, after lithotomy. As for the digestive organs, we need not be surprised that the pain or moral influence of the operation should contribute to increase the disturbance which calculous disorder of the urinary system is so likely to create.

Several minor accidents are apt to follow the operation; but these are of so little importance, that a simple enumeration of them will suffice. The introduction of the lithotrite often excites slight inflammation of the mucous surface of the urethra, followed for a few days by scalding and increased secretion of mucus. The same cause of irritation may give rise to inflammatory action which extends along the spermatic cord to the testicles. The same accidents presents themselves every day in the treatment of diseases of the urethra uncon-

nected with stone; they are seldom severe; but the inflammation of the testicle may occasionally be so acute as to render it necessary to suspend the operation for several days.

The last accident to be noticed is one that was considered almost inevitable at an early period of lithotrity, and the fear of which retarded for many years the general adoption of the operation. I allude to effects produced by the retention of fragments of the calculus in the bladder. Many surgeons formerly held that, even if we succeeded in breaking up the calculus without difficulty into small fragments, some of them must inevitably be retained in the bladder, and there produce not only more or less inflammation, but, what is worse, a relapse of the original disease in an aggravated form, each fragment being converted into a new stone.

If this reproach were well founded, lithotrity must have been abandoned long ago; but fortunately the dangers now mentioned, though in theory they seem very probable, are not found to occur in practice. Reasoning *à priori*, we might conclude that the sharp fragment of a calculus which has been broken up in the bladder should produce much greater irritation of the mucous surfaces than the same calculus had done while whole and smooth. But experience does not confirm the supposition. Great relief is generally produced by mere comminution of the stone, independently of its expulsion; and this perhaps may be explained by the circumstance that the weight of the calculus, and consequently its pressure, on a limited portion of the floor of the bladder are diminished by breaking up the stone.

The shape of the fragment, then, does not necessarily produce irritation; nor, on the other hand, is it impossible either to detect the presence of small fragments in the bladder or promote their expulsion. A careful and methodical examination of the bladder with the lithotrite will generally suffice to determine whether any fragments have been left behind in the bladder; and if none be found—if the patient exhibit none of the symptoms dependent on the presence of a foreign body in the bladder—if the urine continue healthy, we may fairly conclude that the cure is complete. Should any fragments remain, their expulsion from the bladder is to be promoted by the means already described, until that organ is completely freed from the foreign body.

On the other hand, it cannot be denied that relapse often occurs after the operation of lithotrity; I shall therefore now endeavour to explain under what circumstances this accident may take place, and its real connexion with the operation which has been performed.

The question of relapse after operations for the cure of vesical calculus is a very interesting one; yet it has been much neglected by nearly all writers on lithotomy, and M. Civiale is the only author on lithotrity who has examined it in anything approaching to a satisfactory manner.

The following remarks may therefore be interesting, although far from exhausting the subject. We do not, in fact, possess sufficient elements to determine any one of the points connected with the history of relapse after lithotomy and lithotrity, and what is now offered must be taken merely as a contribution towards it.

Writers on calculous disorders generally allude to the possibility of relapse after lithotrity, but in so vague a manner that their remarks are of little assistance to us; while the records of operations for the extraction of stone by cutting have for the most part been kept so imperfectly, that it is impossible to arrive at any certain data for determining the relative frequency of the accident.

The Norwich tables of Mr. Crosse show twelve cases of relapse after 704 operations of lithotomy, or one in fifty-eight. From the records of operations performed at the Hospital of La Charité, in Paris, between the years 1806 and 1831, we find that six cases of relapse presented themselves after seventy cases of lithotomy, or about one in eleven.

M. Civiale informs us that the proportion indicated by returns which he received from Bavaria is five in 162 operations (one in thirty-two); from Bohemia, one in forty-six operations; from Dalmatia, one in forty-three operations.

At the Luneville Hospital, founded by Stanislaus, king of Poland, for the treatment of calculous disorders, the register shows thirteen cases of relapse after 1492 operations of lithotomy, or one in 116 cases.

According to the returns received by M. Civiale from the whole of France, the proportion of relapses appears to be one in seventy-four cases, or thirty-two in 2368 operations; but of these latter, 314 were cases of lithotrity.

The most correct registers are probably those kept at the Norwich and Luneville Hospitals, and from them we learn that relapse occurred after lithotomy once in

fifty-eight cases at Norwich, and once in 116 cases at Luneville.

For lithotrity we possess no other data than those furnished by M. Civiale from his own practice; these are exact and trustworthy, for M. Civiale has published a brief account of every case of calculous relapse after lithotrity which occurred to him. After 548 operations, relapse followed in fifty-five cases, giving a proportion of nearly one in every ten cases.

Such is a general view of the relative frequency of relapse after lithotomy and lithotrity, so far as the documents we possess enable us to go. After lithotrity, every tenth patient may suffer relapse; after lithotomy, the proportion seems reduced to one or two in sixty.

The return of the disease may take place under two circumstances, which it is highly necessary to distinguish. One or more fragments of the original calculus may have been left in the bladder, and become the nuclei of secondary formations; or the bladder may have been completely freed, and the relapse depend on the same constitutional disposition which gave rise in the first instance to the deposit of calculous matter from the urine. The latter cases are simple recurrences of the disease, and cannot be connected with the operation, whether it be lithotomy or lithotrity; but in the former we cannot avoid attributing the accident in great measure either to the operator or to the method which he has employed.

It is not always easy to distinguish whether the new calculus, in cases of relapse, has been formed on fragments left behind in the bladder, or is merely a product of the original calculous diathesis, yet unless

we make this distinction, it is clearly impossible to say how far the operation of lithotrity should be held responsible for the relapse.

When the formation of the second calculus depends on continuance or return of the original diathesis, a certain interval of time generally elapses between the operation and the appearance of the secondary accidents. The patient may enjoy perfect immunity for many months, or even several years. The secondary calculi, if I may so call them, are likewise often of the same kind as those primarily developed. This was observed in one-half of M. Civiale's second series of cases. The calculi are usually single. Now, when relapse occurs in consequence of the retention of fragments, the opposite of all this will be observed. The patient never completely ceases to suffer after the operation. For a time he may complain less than usual, but the painful sensations inevitably connected with the presence of a foreign body in the bladder are sure to recur. The calculi of relapse from retention of fragments are, as we might expect, commonly several, not single, though there are many exceptions, and these secondary formations, more or less rapidly constructed on the nuclei of the original stone, are very often of the phosphatic kind. The irritation of the bladder, caused by the operation or by the fragment, explains this tendency to the deposition of phosphatic calculi, and, indeed, a quantity of friable matter may be rapidly thrown down from the mere effect of inflammation or high irritation of the mucous surface, in cases where no trace existed of a calculous fragment having been left behind in the bladder.

The practical deductions which I would draw from the preceding remarks are chiefly two. In the first place, we are not to consider the patient as completely cured, and abandon him to nature, because the foreign body has been removed from his bladder. The calculous diathesis may remain, and unless proper medical treatment be employed to correct it, relapse may occur, and the occurrence be set down to an operatian which has been guiltless of it. This applies to lithotomy as well as to lithotrity. By the former, the whole of the foreign body is usually removed; but the operation leaves the constitutional disposition untouched: the calculus may be re-formed again and again. Patients have been cut as many as four times.

The second point I would notice is the necessity of paying great attention to the state of the bladder after all operations of lithotrity. We may have succeeded in removing every trace of fragment, and believe the patient free from all danger of relapse; yet if any severe irritation of the bladder be allowed to continue, there is great risk of the deposit of the phosphates, which sometimes takes place in great abundance, and in a surprisingly rapid manner. Fortunately this new matter is of a friable nature, more like mortar than a calculus; it is easily crushed, and its removal seldom entails any unpleasant consequences.

Relapse, then, is not an accident peculiar to lithotrity. It occurs after lithotomy likewise, but much less frequently.

It is important, therefore, to determine whether any fragments have been left behind in the bladder, and it must be carefully examined to ascertain this point.

Many surgeons trust to the ordinary sound, but a small lithotrite, with broad, flat blades, is a much better instrument. A few ounces of cold water are to be injected into the bladder, and the injections are to be repeated two or three times until that organ has become contracted, and any mucus or coagulated blood contained in it has been expelled. When the operator feels that the coats of the bladder have contracted round the lithotrite, the instrument is to be carefully rotated, and its blades made to come in contact with the walls of the bladder in every direction. This will occasion some pain, but it is seldom so severe as to prevent us from continuing the examination, at the termination of which no one, accustomed to this kind of sounding, can fail to determine whether the bladder contains a single fragment of the calculus. For the great majority of cases, at least, this is true. In exceptional cases, however, when the prostate is much enlarged, the bladder hypertrophied, and whenever deformed by cysts, or unable to expel its contents from partial paralysis of the muscular fibres, the examination must be conducted with the utmost care, and does not always lead to a satisfactory result.

In these cases, if the patient continues to experience any uneasy sensation at the time of passing water, or afterwards, and if the urine is turbid or ammoniacal, we may conclude that the bladder has not been entirely freed from the foreign body.

CHAPTER VII.

PATHOLOGICAL EFFECTS OF URINARY CALCULI.

THE propriety or inexpediency of operating in any given case of stone, in other words, the indications, mainly depend on the condition of the genito-urinary organs; it may, therefore, be of use to describe the various effects produced by vesical calculi on the urethra, prostate, bladder, and the urinary system in general.

In the following remarks I shall confine myself to a notice of those changes which are more immediately connected with lithotomy and lithotrity. A few words on some physiological effects of vesical calculi may, however, be useful.

The urethra does not necessarily suffer from the presence of a stone in the bladder ; the morbid changes observed in the urethral portion of the genito-urinary system generally depend on the development of small calculi in the canal, or on their stoppage in it during their passage from the bladder; but the effects of vesical calculi are sometimes exercised sympathetically on the urethra. These arise chiefly from irritation, which

extends sometimes forwards along the urethra, as it unquestionably often does upwards along the ureters to the kidney. We can conceive how great and long-continued irritation from a foreign body in the bladder may give rise to inflammation of the urethra, and possibly to inflammatory stricture of that canal; but this is a very rare occurrence. The disorder of the urethra, in the great majority of cases, is merely functional, and consists in a modification of its sensibility or contractile powers. Hence spasmodic stricture of the membranous portion of the urethra, is a frequent attendant on vesical calculus; the irritation excited by the pressure of the foreign body on the neck of the bladder is propagated forwards; the muscles and tissues of the membranous portion are frequently stimulated to contraction; and at last that form of stricture well known under the name of "spasmodic" is established.

Such a condition exercises no influence on the operative proceeding in lithotomy; but it offers an obstacle to the introduction of lithotritic instruments, and impedes the subsequent manipulations. The sensibility of the urethra and neck of the bladder may be modified, and this morbid change is still more frequent than the one first alluded to. Even in the healthy state the sensibility of the urethra is very capricious, if I may use the expression. The introduction of a gum-elastic bougie will produce a sensation of fainting or sickness in some healthy people, in others again an attack of fever. When stricture exists, the morbid sensibility is greatly increased, and the tendency to sympathetic disturbances aggravated in a proportionate

degree. Severe constitutional disturbance, nervous affections of various kinds, and even death itself, have ensued on the mere passing a catheter into a stricture. It is not, therefore, surprising that the sensibility of parts which are so apt to resent disagreeable impressions when they are in a healthy state, should be frequently and greatly modified by irritation of the bladder.

Experience proves this to be the case. In calculous patients the urethra and neck of the bladder are often affected with such a degree of morbid sensibility, that the introduction of any instrument whatever becomes impossible, and if injudicious attempts be persevered in, the consequences may be disastrous. Such patients are generally of a highly nervous temperament, and the sympathetic disturbance of the system may under such circumstances assume a dangerous character. In less unfavourable cases the morbid sensibility of the parts does not altogether exclude the use of instruments; but their introduction produces very great pain, excites spasmodic contraction in the neck of the bladder, and gives rise to several secondary effects of a severe character. When this state depends on mere temperament, it may be greatly alleviated by proper treatment; but when it is connected with organic disease of the bladder, it presents, as I shall explain by and by, an almost insurmountable obstacle to the performance of lithotrity.

The same modifications of sensibility and contractility may be observed in the bladder, as a consequence of stone. This we can readily understand, for here the foreign body acts directly on the organ. In nearly all old cases of vesical calculus the bladder has more or less

tendency to contract with force on the fluid or solid matter contained within its cavity. This is a natural consequence of the presence of a foreign body, to expel which the bladder is incessantly stimulated. The morbid contractility of the organ is manifested by an urgent and constant desire to void the urine. This may be carried to a very great degree: the bladder will not hold more than a spoonful or two of urine at a time; and if a couple of ounces of fluid be injected into it, the injection is instantly thrown back with force. When the calculus is large, the bladder from its contractility, often envelopes the foreign body in a close grasp; and this state of parts is highly unfavourable for any operation. It renders lithotrity impossible, and is scarcely less unsuitable for extraction of the stone by lithotomy.

An opposite condition of the bladder is occasionally met with as an effect of calculus. It occurred in one of the last patients on whom I operated in St. Mary's Hospital. Instead of contracting violently on its contents, the bladder seems to have lost more or less of its expulsive powers, it becomes sluggish, allows the urine to accumulate in considerable quantity, its sensibility is diminished; the organ, in fact, is struck with atony or partial paralysis. This is a very insidious state, for it masks many of the symptoms of stone; and though it may offer no obstacle to lithotrity, it exercises a great influence on the results of the operation, by favouring, on the one hand, retention of urine, and on the other, by impeding the free discharge of the detritus from the bladder. To avoid repetition, I shall defer further notice of atony, until I come to indications.

The pathological effects of vesical calculus at an

early stage have not been accurately determined by post-mortem examination, for the disease is never fatal at the commencement; but the symptoms indicate plainly enough the changes which are going on within.

At first they are those of irritation, soon followed by unequivocal signs of chronic inflammation of the parts which have been irritated. The most common, indeed it might be said almost constant, effect of stone in the bladder, is to excite more or less inflammation of the mucous membrane with which it comes in contact. It is true that some calculous patients suffer little, and that a few have even remained unconscious of the disease under which they laboured, the symptoms being completely latent. But such cases are extremely rare. Stone in the bladder seldom exists for any length of time without producing more or less inflammation of the mucous surface of that organ, which may extend either to the other tissues of the bladder, to the neighbouring cellular substance, to the prostate, or upwards to the ureters and kidneys. The inflammation may be either acute or chronic. We might naturally infer that the severe irritation of a rough calculus, grasped, as it often is, by a contractile bladder, while the urine is at the same time highly offensive and irritating, should often produce acute inflammation of the mucous membrane: but this is not the case; the bladder is patient and long-suffering to an astonishing degree, and acute inflammation of this organ rarely sets in, except towards the last stage, when the disease draws to its close, and death is at hand.

Chronic inflammation of the mucous membrane of the

bladder may exist in every degree of intensity. Its pathological characters are too well known to require description.

The inflamed points present a dark-red colour; and when the disease has continued for a long time, the inflamed spots assume a much darker tint, while the membrane itself becomes thickened, pulpy to the touch, and softened, tearing easily away from the subjacent tissues. If the complaint continues, and the patient dies, the mucous membrane, especially in the neighbourhood of the neck of the bladder, is found greatly discoloured, of a brown or even blackish tint; and this may occur with or without softening. The symptoms of this chronic inflammation are those of catarrh of the bladder; and it may not only be an effect but a cause of calculus, for the inflammation is a strong predisposing cause of phosphatic deposits.

Inflammation of the bladder may present any of the terminations peculiar to inflammation in other parts of the body. Gangrene is very rare, suppuration frequent. The urine of calculous patients very often contains pus in greater or less quantity. This pus is generally secreted by the inflamed mucous membrane; but pus may also be deposited in the substance of the bladder, either in the form of infiltration, or small disseminated abscesses. In a few cases the pus is deposited in the cellular tissue outside the bladder. The loose cellular web between the bladder and the rectum is the most frequent seat of this latter lesion, which commonly ends in infiltration of urine, sloughing, and death, an event the more likely to occur if an operation has been imprudently performed.

Ulceration of the mucous coat also occurs as an effect of inflammation from calculus. This lesion is not very rare ; still it seldom ensues, except in old cases, and in the last stage of the disease, with rough calculi, when severe inflammation has softened the mucous tissue, on which the stone is pressed by forcible contractions of the bladder. The ulcerations are usually found near the floor of the bladder, on which the calculus commonly rests. They may proceed so far as to cause perforation of the organ, sometimes followed by the escape of the calculus from the cavity of the bladder, and always by fistulous infiltrations of the most dangerous kind.

Next to inflammation of the mucous membrane, which, I should remark, sometimes extends by continuity to the other constituent parts of the bladder, comes hypertrophy of the muscular tissue ; it might perhaps be said that it is of more frequent occurrence, for more or less thickening of the muscular coat is the necessary consequence of the efforts which the bladder is constantly stimulated to make, in order to expel the foreign body or the offensive secretions it contains. This is an important lesion in reference to lithotrity, and presents itself in a variety of degrees. Sometimes a few of the muscular fibres only are developed, at other times we find a number of thickened fibres collected into bundles, and standing out like the carneæ columnæ of the heart, constituting what French writers term, "la vessie à colonnes."

The fleshy columns may, moreover, cross each other in various directions ; and this is an unfavourable circumstance, for it may render it very difficult either to

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detach or seize a small calculus, which gets entangled between the recesses, and escapes the instrument. It likewise favours what is called adhesion of the calculus to the bladder. The stone does not literally adhere, but any projection on its surface may get entangled amongst the net-work of the hypertrophied fibres, and the effects of adherence be thus virtually produced. In a few cases the hypertrophy seems to have extended from the muscular to the cellular tissue of the bladder; the three coats of the organ, in fact, are thickened; and when to this we add contraction, we can understand how the walls of the bladder sometimes undergo an astonishing degree of thickening. Chopart speaks of half an inch; other writers mention hypertrophied bladders the walls of which were more than an inch in thickness.

The hypertrophied condition of the muscular fibres leads to another pathological state, the existence of which exercises great influence on operations for stone. In many cases of hypertrophy, the bladder, instead of being contracted, is dilated; or the fleshy columns of an hypertrophied bladder leave intervals between them, in which the mucous and peritonæal coats remain without support. Now, when the bladder contracts violently on its contents, we can readily understand how the mucous coat may be pushed outwards between the muscular bands, forming pouches, sacs, or cysts, as they have been variously called. This lesion is not of rare occurrence in calculous patients.

A celebrated French lithotomist asserts that he met with thirteen cases of encysted stone in fifty patients on

whom he operated. These cysts or sacs are chiefly found near the floor of the bladder; they are of various shapes and sizes, sometimes single, but oftener multiple. The opening into them may be wide, or narrowed from contraction of the muscular fibres round the neck of the sac. The calculi frequently become engaged in these sacs, and it sometimes happens that the stone lodges in them for a certain period only, being occasionally expelled from their cavities by the contractions of the bladder. This often leads to errors and uncertainty of diagnosis. As many as seven calculi have been found in one of the cysts now spoken of, yet the entrance was barely wide enough to admit a goose-quill. After lithotrity the fragments likewise may become engaged in these recesses, and give rise to a great deal of trouble. A case is recorded in which the operator took six months to free the bladder completely from the detritus.

The sojourn of the fœtid urine in these cysts often excites purulent inflammation of their walls, a most unfavourable complication (*see* Figs. 63 and 64, pp. 128, 129), which the late Mr. Liston, as I am informed, had more than once noticed; in fact, these cysts sometimes contain true pus, while the bladder with which they communicate contains only urine; but experience unfortunately teaches us that we cannot determine the existence of this lesion during life with any degree of certainty. M. Civiale says that he has often been led to suspect the presence of cysts in the bladder by observing the manner in which the fluid injected into that organ is expelled by it: the fluid does not escape in a regular flow through the catheter, and the last portion

passed is often more turbid and offensive than the first.

Besides the projecting and hypertrophied columns of which I have now spoken, we sometimes find a different species of folds, produced by the mucous membrane alone, which is relaxed and at the same time engorged, being of a blue or purplish character. These folds sometimes become encrusted with phosphatic deposits, while from their arrangement, they are very liable to be pinched between the blades of the lithotrite; and the same remark applies, though in a less degree, to the hypertrophied columns. For the bar at the neck of the bladder I must refer to what has been said under Obstacles.

The irritation of a calculus in the bladder sometimes gives rise to the development of tumours about the neck of this organ (*see* Fig. 66, page 133). These are either of a fungoid character, or resemble polypi; in some rare cases they are firm, or exceedingly hard and cartilaginous. Their most frequent seat is the neck of the bladder, but they have been found to arise from its fundus and other parts. They vary greatly in size and consistency, being sometimes as large as a hen's egg, or even as the closed fist. The calculus sometimes appears to grow into them, while at other times they are found covered with calcareous or phosphatic deposits. They modify the symptoms of stone, and often give rise to a peculiar form of retention of urine, from the tumour being driven against the internal orifice of the urethra. It is unnecessary to mention that they must impede more or less the operation of lithotrity; the friction of the instruments is very apt to inflame them or make

them bleed ; but considerations of this kind may be appropriately reserved for the next chapter.

Having thus noticed the principal lesions of the bladder connected with or consequent on stone, the prostate next presents itself for consideration. Chronic disease of this gland is of very frequent occurrence in calculous patients, though it may likewise exist, in old persons especially, independently of any calculous affection. The irritation to which the neck of the bladder is constantly exposed seems to determine an abnormal degree of nutrition in the gland, and it thus slowly enlarges. In other cases, the tumefaction is, however, connected with chronic inflammation of the tissues of the gland.

The changes in the size, form, and consistency of the gland are very diversified ; sometimes the tumefaction is slight, at others considerable. It then projects into the bladder, causes retention of urine, and many other distressing symptoms. The tumour is usually firm, but sometimes soft ; in other cases it is of a scirrhous hardness. Any one or all of the lobes may be enlarged. Sometimes the tumefaction is uniform, and the gland acquires very great dimensions, but often the hypertrophy is confined to the middle lobe, which projects in a conical manner into the bladder behind the internal orifice of the urethra, and often attains a large size.

Enlargement of the prostate always exercises more or less influence on the operation of lithotrity. It may impede the introduction of instruments and the seizing the stone, for the urethra may be deformed, its internal orifice pushed back, or the floor of the bladder more or less deepened. When this enlargement exists to any

great degree, it contra-indicates lithotrity. It is important to distinguish chronic enlargement of the middle lobe from the various kinds of tumours about the neck of the bladder, of which I have spoken already, but this is not always easy. The practitioner should chiefly be guided by the anatomical position of the gland, by the manner in which the middle lobe springs, as it were, from the under surface of the neck of the bladder, and by the large basis on which it is supported.

The enlargement of the prostate may be either interstitial—that is to say, simple hypertrophy of the tissues —or it may depend on chronic inflammation of the organ. This latter form, I believe, is the one which usually presents itself in calculous patients, and hence two of the effects of inflammation—viz. suppuration and ulceration — are occasionally observed in the prostates of patients labouring under stone in the bladder.

Abscess of the prostate is not very uncommon ; it may occupy the substance of the gland, or commence in the excreting ducts. The external cellular membrane may also, in some cases, be the seat of the purulent collection, but the symptoms are often obscure. The abscess itself may open into the urethra, the bladder, the rectum, or the perinæum. It is unnecessary to repeat, that any considerable tumefaction of the prostate must alter, more or less, the shape, direction, and calibre of the prostatic portion of the urethra, render catheterism difficult, and impede or render impossible the operation of lithotrity. These points, however, will be fully examined in the next chapter.

That portion of an inflamed or tumefied prostate

which projects backwards into the cavity of the bladder, is sometimes the seat of ulceration; but this very seldom takes place, except towards the termination of the disease. The sufferings of the patient from this complication are dreadful, and it exercises a most unfavourable influence on any operation to which we may have recourse. In old patients affected with calculi we sometimes meet with a peculiar structure at the neck of the bladder, which Mr. Guthrie has well described, under the name of "bar of the neck of the bladder." This occasional effect of vesical calculus has been described amongst the Obstacles.

Atrophy of the prostate has sometimes been found in calculous patients; but it is impossible to connect this lesion with stone in the bladder as effect and cause. It is more probably a coincidence depending on some other influence which escapes our detection. The prostatic portion of the urethra is widened in cases of this kind. The calculus often lies close on the neck of the bladder, and if lithotrity be had recourse to, the fragments are very apt to become impacted in the vesical extremity of the urethra.

The only pathological effects of vesical calculus which it remains for me to consider, are those produced on the ureters and kidneys. The ureters are seldom found in a completely healthy state when the bladder has been subject for any length of time to the irritation of a calculus; more or less dilatation of these tubes is the lesion ordinarily discovered, and its degree will depend on the obstacle offered to the free discharge of urine from the bladder, for I do not now include cases in which the ureters themselves may be the seat of cal-

culi. I speak only of the effects of vesical calculus on these parts.

The dilated ureter is often inflamed, though inflammation of the internal membrane may exist without any change in the calibre of the duct. The inflammatory action is usually propagated upwards from the bladder, which is itself in a state of sub-acute inflammation, and the latter often extends to the pelvis of the kidneys, and thence to the substance of these organs. For a more complete description of this complication I would refer to a memoir on Pyelitis, which I published in the "London Journal of Medicine," for June, 1852. Inflammation of the mucous lining of the ureter or pelvis is almost always attended by a secretion of pus, which sometimes distends the pelvis to such a degree as to produce complete absorption of the substance of the kidney.

The secreting urinary organs themselves often become implicated during the progress of calculous affections of the bladder, either directly by the upward extension of inflammation along the ureters, or by sympathy. These secondary diseases constitute a most important point in relation to lithotrity, for they exercise more influence on the results of the operation than even direct lesions of the bladder itself; while, at the same time, they are of so obscure and insidious a nature as to escape, in many cases, the notice of experienced practitioners. In old cases of stone in the bladder, the kidneys are seldom found healthy; and in other cases of shorter standing, they are very apt to become implicated by the disorder which already exists in the bladder.

The lesions of the kidney thus connected with vesical calculus are numerous and of various degrees of intensity. The most ordinary are chronic degeneration or inflammation of the substance of the organ. In the early stages the glandular structure becomes injected, more soft and vascular than is natural. As the disease advances, we find the usual effects of inflammation; pus is secreted at an early period, and often in a rapid manner; numerous small abscesses are found under the peritonæal coat, or disseminated throughout the substance of the kidney; in rarer cases, the pus is collected into one large abscess.

The kidney sometimes presents an appearance of hypertrophy. It is then uniformly enlarged, and often of firm consistence, but sometimes soft. In more rare cases we meet with atrophy of the kidney, or the glandular structure has entirely disappeared, and the organ is reduced to a mere cyst. This wasting, however, generally arises either from the presence of a calculus in the kidney, or from the pressure of purulent matter confined in the pelvis. The body of the celebrated anatomist, Malpighi, presented an example of atrophy of the kidney.

In addition to these lesions, which can be clearly traced to the influence of the vesical calculus, other morbid states have been met with in calculous subjects. Thus the kidney has been found reduced to a pulpy mass, resembling the spleen in its composition; it is sometimes the seat of tumours of various kinds, and often contains hydatid cysts, occupying more or less of the substance of the organ. Such kinds of lesions may not perhaps depend essentially on the presence of stone

in the bladder, for they are often found in the bodies of persons who never suffered from that complaint.

As I have already observed, the symptoms of renal disease connected with or supervening on stone in the bladder are often of a very obscure kind, and apt to escape detection; yet the surgeon must pay the closest attention to the condition of the kidneys in every patient whom he may have to treat for the stone, whether by lithotomy or by lithotrity. The local signs of disease of the kidneys are often extremely vague; the general symptoms may be readily referred to constitutional disorder from the calculous affection of the bladder, and not to the kidney itself: yet if we operate on a patient affected with organic disease of the kidneys, he will almost certainly die, and the cause of the fatal result be attributed to the operation.

CHAPTER VIII.

INDICATIONS AND CONTRA-INDICATIONS OF LITHOTRITY.

THE various points connected with the indications and contra-indications of lithotrity are of the most important kind, and require to be considered with the utmost care. The success of lithotrity mainly depends on its being applied in a proper manner; that is to say, on a strict observance of the indications which experience has established. The surgeon may possess the most perfect instruments, he may operate with the greatest dextrity and skill, but his talent will be thrown away and his hopes disappointed, unless he knows how to distinguish those cases to which lithotrity is applicable, from the numerous other cases where lithotomy should be preferred, or where an operation of any kind is inadmissible. Lithotrity, I cannot too often repeat, can only be judged by its results in those cases for which it is destined, and they who venture to push it beyond its legitimate bounds will reap nothing but disappointment.

A number of calculous patients present themselves to us. Is lithotrity applicable to them all, without dis-

tinction? Most assuredly not. On what, then, are the distinctions to be founded? On what principles are we to accept some patients while we reject others? What, in short, are the indications and contra-indications of the operation? These questions involve a great variety of details, and have given rise to much diversity of opinion, even amongst our best surgeons. They can only be determined by experience; yet, strange to say, any obscurity which still hangs around them arises from the fact, that many leading surgeons would resolve them according to their personal experience. This may seem a paradox, yet it is true. The fact is, that most surgeons perform lithotomy sufficiently well, yet when they come to lithotrity, judgment and skill seem to have abandoned them. The dextrous lithotomist suddenly becomes a very indifferent lithotritist. An eminent hospital surgeon, who cut eighteen patients without losing one, could never perform lithotrity in a respectable manner; and the results of M. Velpeau's practice were of a deplorable kind. Of the first twelve patients on whom M. Velpeau operated, no less than three died; in four he had to abandon the operation, not being able to terminate it; and five were cured. This unpromising *debut* sufficiently explains the determined hostility which M. Velpeau has ever since shown against lithotrity, and as the same results occurred in the hands of other surgeons at an early period, it is not astonishing that when they speak of it from their own experience, they should either condemn it altogether, or confine it to a very limited number of cases.

If we take up the question of the applicability of

lithotrity in the abstract, and ask to how many cases out of a given number it is applicable, the answer is difficult. The records of surgical science on this interesting point are excessively meagre. The noise of successful cases seems to drown every other. Very few operators have published an account of their practice with sufficient details; and this reproach applies to lithotomists almost as generally as to lithotritists. M. Velpeau asserts that lithotrity is applicable in about a quarter only of the cases of calculous patients which may come before the surgeon. M. Amussat, even so far back as 1835, declared that he found lithotrity applicable to three-fourths of the calculous cases in his extensive practice. Sir Philip Crampton—who forcibly insists on the expediency of operators publishing the whole results and details of their practice, and who has set an example which so few follow—Sir Philip Crampton had occasion to treat thirty-five calculous patients within a period of eleven years, and of these two were considered unfit for any operation, twenty-four were lithotritized, and nine were submitted to lithotomy. This gives nearly the same proportion as that of M. Amussat, viz., three-fourths of calculous cases to which lithotrity was applicable. The late Mr. Key, who was no warm advocate of lithotrity, said, that "more than half the number of adults who came under his care with stone were fit subjects for lithotrity." To M. Civiale we must turn for anything like satisfactory information on this, as on almost every other point connected with lithotrity. M. Civiale has kept accurate notes of every case treated by him during the last six-

and-twenty years; nay, more, he has published short notes of every one of these cases, and thus furnished elements for the solution of many questions which a more limited practice could not have embraced.

Between the years 1824 and 1836, M. Civiale saw 506 calculous patients. Of these he rejected 199 as unsuited to the operation of lithotrity, and operated on the remaining 307. Hence about two cases in every five were rejected during this period. From 1836 to 1845, M. Civiale saw 332 calculous patients: 91 were rejected, and 241 operated on; two cases in every seven were rejected during this period; or, taking both periods together, we have 290 cases out of 838 rejected, being a proportion of about one-third. This latter is perhaps as near the true proportion as we can get; but we must remember that it applies to adults only. If any considerable number of children had been comprised in M. Civiale's 838 cases, the proportion would have undergone very great modifications. The best calculations show that nearly one-half of all calculous patients are children; and if these latter be given over to lithotomy, then the proportions are altered; sixty-six patients in every hundred would belong to lithotomy, and thirty-four to lithotrity. This, I believe, is as close an approximation to the truth as we can arrive at now; it gives to lithotrity about thirty-four per cent. of all the cases of vesical calculus which occur; and two-thirds of the cases, if we confine ourselves to adults. But even this might admit of some correction; for it is probable that ten per cent., if not more, of calculous patients are rejected by the litho-

tomist also as unfit for lithotomy, which would bring the numbers pretty nearly to the same point.

General reasoning, however, of this kind, furnishes no information of any practical value to the surgeon. We must descend from the mass of facts to particulars, and endeavour to ascertain on what principles one-third or two-thirds of the cases of vesical calculus which may present themselves to us should be excluded from lithotrity. In order to render these principles more clear, and more easily understood, I must again call to mind in what the operation of lithotrity consists. To perform this operation in a safe and proper manner, and to derive from it the results which it is capable of yielding, certain conditions are requisite. Thus, we must be able to introduce our instruments into the bladder. Having introduced them, we must be able to seize and fix the calculus. Having fixed the stone, we must be able to break it up into small fragments; and the fragments thus comminuted must have a ready exit from the bladder. Finally, these various steps of the operation must be performed without exciting any serious disorder in the urinary organs, without aggravating in a dangerous way any disorder which may already exist, or without inflicting any important injury on the general health of the patient. To perform lithotrity in a successful manner, the different conditions which I have just enumerated must be strictly fulfilled, and we have therefore only to ascertain what circumstances prevent the fulfilment of these conditions, in order to discover the indications and contra-indications of lithotrity. Whenever, in any given case, the surgeon cannot entertain a reasonable hope of attaining the

conditions which are essentially necessary to a successful performance of the operation, the latter is contra-indicated.

The contra-indications arising from any obstacle to the introduction of lithotritic instruments into the bladder have already been noticed under the head of obstacles. We must suppose that the urethra is sufficiently free to allow the passage of the lithotrite.

The principal points on which the applicability or non-applicability of lithotrity, in any given case, depends are, first, the nature of the calculus; second, the condition of the urinary organs; and, third, the health of the patient, with some other circumstances of a general nature, as age, &c.

As regards the nature of the calculus, the choice of the operation to be selected will be influenced by the number of calculi in the bladder, their size, their form, their density, and position. All surgeons are agreed that a single calculus is more suited to lithotrity than several calculi; but it is impossible to lay down any rule from number alone. Generally speaking, the existence of more than two calculi may be regarded as an unfavourable circumstance; but M. Civiale has operated with success in a case where the bladder contained forty calculi; and M. Leroy d'Etiolles in cases where fifteen, twenty, or thirty calculi were present. These cases prove that lithotrity is not contra-indicated by the mere number of calculi taken in the abstract; what we are to be guided by is the time which may be required for crushing and getting rid of them, because then we bring into account one of the conditions already enumerated, viz., that of not inflicting any injury on the urinary

organs or general health of the patient. Hence the number of calculi is no great obstacle, provided they be at the same time small and soft; provided we can crush each at once, without being forced to prolong manipulations which might fatigue and irritate the bladder.

When small, and of a friable nature, the calculi, however numerous, may be regarded rather in the light of fragments. On the other hand, should any great sensibility of the neck of the bladder or of the organ itself co-exist with a number of calculi, it will be more prudent to reject lithotrity.

The size of the calculus is an important element to be taken into account. Formerly our notions as to the size of the stone were extremely vague; but since the discovery of lithotrity surgeons have arrived at much greater accuracy, and the size of a calculus can now be generally ascertained in a manner sufficient for practical purposes. A calculus may be regarded as of moderate size when it does not exceed an inch and a half in diameter. Here the operation of lithotrity, so far as the size of the calculus is concerned, is perfectly applicable. Even when the stone measures from an inch and a half to two inches and a half, it may be crushed, provided it be not very hard, and the urinary organs be free from disease. Mr. Massey, of Nottingham, has recently related two very instructive cases of this kind. He does not mention the size of the calculi, but they were evidently large; the aggregate weight of the detritus is estimated at two ounces and a half; they were likewise hard, being composed of lithic acid and lithate of ammonia; yet they were removed by crushing and percussion without any accident. Still it must

not be forgotten that the operation for the destruction of a stone from two inches to two inches and a half in diameter, and moderately hard, is often difficult, and followed by unfavourable symptoms.

The late Mr. Key says: "I know of no limit to the size of a calculus removable by lithotrity, but the power of the lithotrite. If a powerful instrument can be brought to embrace it, and the bladder be healthy, the operation may, as far as my experience goes, be attempted with propriety." The opinion of Mr. Key requires some qualification; very great size is no contra-indication, provided the calculus be very friable, as phosphatic deposits usually are, and provided the bladder is not closely contracted over the surface of the foreign body. If, however, the stone be large, and at the same time dense, I would say that lithotomy should be preferred to lithotrity, even admitting, with Mr. Key, that the urinary organs are healthy. The necessity of our being able to operate without the danger of over-exciting the bladder must never be forgotten. A large dense stone cannot be reduced to fragments either by percussion or crushing without a considerable number of operations. As the calculus occupies a great part of the cavity of the bladder, it is not easily seized; the manipulation of crushing must be more or less painful, and is always long; the danger of exciting inflammation of the bladder or kidneys is proportioned to the number and length of the operations; such danger is always imminent; the quantity of detritus is likewise great, and retention of the fragments after fatiguing operations may give rise to serious constitutional disturbance. From these and other reasons, I would lay it down as a

rule that lithotrity is contra-indicated in all cases where the calculus is at the same time large and dense. In cases where the foreign body is moderately hard, and does not exceed two inches and a half in diameter, other circumstances being favourable, the operation is not altogether contra-indicated; but if had recourse to, the greatest caution is required, and the operator must be prepared to abandon any further attempt at crushing as soon as unfavourable symptoms arise. In these and other cases, which occupy what I would call neutral ground, or the limits between the applicability and non-applicability of the operation, much will depend on the skill and experience of the operator. One surgeon will succeed where another fails; and unless the practitioner has full confidence in his own resources, it will perhaps be more prudent for him to follow the beaten track, and have recourse to lithotomy in the doubtful cases to which I now allude.

The density of the calculus is next to be noticed. The mulberry or oxalate of lime calculus is the hardest variety and often presents such a degree of density, that no force will produce any effect on it. Professor Velpeau mentions a case of mulberry calculus, where 2000 strokes of the percussor were had recourse to without exercising any perceptible influence on the foreign body. Calculi of this kind are evidently beyond the domain of lithotrity; and other cases of hard calculi are to be rejected whenever we have reason to suspect that the hardness of the stone, whether alone or joined to other circumstances, may exercise an unfavourable influence over the results of the operation.

It is clear that a very hard calculus cannot be disin-

tegrated without a considerable number of operations, and the possible consequences of such repeated manœuvrings in the bladder are sufficient to make us incline to the side of lithotomy.

On the indications connected with the form and position of calculi, little need be said. The stone must be seized and fixed before it can be crushed, and there may be some difficulty in grasping a very flat calculus; but with our curved instruments this difficulty is, I believe, very rarely insurmountable.

The condition of the urinary organs, is the next point to be examined in reference to the indications of lithotrity. It is almost unnecessary to say that a healthy state of the urinary organs is the most favourable condition that can present itself in connexion with lithotrity, while, on the other hand, any serious organic disease of the bladder or its appendages contra-indicates the operation. Still, few calculous patients are altogether free from some disorder of the urinary apparatus, and many affections of the bladder merely influence the results of lithotrity without absolutely contra-indicating it. Hence it is a matter of great importance (although much easier in theory than in practice) to ascertain what morbid conditions of the genito-urinary system are incompatible with the safe and successful application of lithotrity.

The state of the prostate first demands our attention, for it may influence the simple introduction of the instruments, as well as the operation and its results. In a former chapter, I described the different morbid conditions of the prostate which have been found in connexion with vesical calculi; one or both of the lateral lobes

may be increased in size; the middle lobe also may be enlarged, and form a more or less prominent tumour, which projects backwards into the cavity of the bladder. The substance of the gland may be inflamed, its vesical surface may be the seat of ulceration, or, finally, abscesses may exist in the body of the prostate itself.

Partial or total enlargement of the prostate must necessarily cause some deviation of the prostatic portion of the urethra, and thus create a greater or less obstacle to the introduction of instruments. When the enlargement is moderate, we generally succeed in overcoming the obstacle by depressing the handle of the instrument a little when its point arrives near the pubic arch; and a greater degree of enlargement will require a corresponding amount of depression. The curve of the instrument is thus carried over the enlarged gland without any considerable difficulty, but great care and gentleness are indispensable; the operator must avoid dragging the parts too much, which would excite severe pain; and he must also avoid injuring or perhaps lacerating the superior surface of the prostatic portion of the canal, which might occur if the handle of the instrument be depressed too low.

It is easy to understand how any considerable enlargement of the prostate—particularly of its middle lobe—must diminish the cavity of the bladder, and thus impede the free play of instruments within this organ. The tumefaction of the middle lobe, which projects backwards, deepens the floor of the bladder, and the calculus is thus often concealed in a kind of artificial cavity; the antero-posterior diameter of the bladder is also more or less altered and prolonged backwards. These

circumstances are calculated to impede the manipulation after the introduction of the lithotrite. The rotation of the open blades is circumscribed, and the seizing the calculus is thus rendered more difficult. Indeed, when the middle lobe of the prostate is greatly enlarged, it may be impossible to grasp the stone without executing a movement of complete rotation, and turning the concave surface of the instrument against the gland.

The same disposition of parts which prevents us from seizing the calculus with facility must also impede the ready discharge of fragments from the bladder ; and this is an objection of great importance.

Fig. 60.

Fig. 60.—A calculus in the prostatic portion of the urethra, and a second one in the depression behind the prostate. The point of the sound passes over both.

Enlargement of the prostate gland is an unfavourable circumstance for the performance of lithotrity, but it is no absolute contra-indication, as some writers assert, nor, on the other hand, is it to be regarded with indif-

Fig. 61.

Fig. 61.—Effect of enlargement of the prostate gland, throwing up the point of the sound.

ference. The main points to be ascertained, before deciding on the propriety of operating, are the nature and extent of the obstacles which the enlargement of the gland may oppose. These can only be determined by a very careful examination of the patient with the sound and finger. By introducing the finger into the rectum, &c., we must obtain as correct a notion as possible relative to the size of the gland; we must ascertain whether the whole or a part only of the prostate be enlarged, and if a part, whether it be the lateral or middle lobe; we must observe how the urethra has become altered, whether to the right, or left, or upwards. We must endeavour to find out, if possible, how far the middle lobe of the prostate projects backwards into the cavity of the

bladder, and what is the form or extent of the pouch in the floor of the bladder on which the calculus rests. All this requires dexterity and judgment, but it is necessary to obtain such preliminary knowledge, unless we prefer going to work in the dark; and it has been clearly established that the want of success, in many cases of lithotrity, mainly depends on the operator having neglected to ascertain beforehand certain conditions, on an acquaintance with which the ultimate success of the operation intimately depends.

Let us now suppose that on examination we have discovered some enlargement of the prostate, but not to any considerable extent. Here we may proceed to operate, provided the stone be of moderate size, and the organs not very sensitive. On the other hand, when the increased size of the prostate is considerable, and the bladder contains several calculi or a single large one, lithotrity is contra-indicated.

Any serious disorder of the urinary organs co-existing with enlargement of the prostate, should, in my opinion, be also regarded as a contra-indication. Thus the neck of the bladder is often very irritable in cases of the kind now under consideration; there may be chronic catarrh of the bladder, or that organ may be in a state of atony, &c.

Lithotrity has been successfully employed in spite of these complications; but whenever they exist in conjunction with enlargement of the prostate, I should, for my part, prefer having recourse to lithotomy. These principles may also be applied to cases in which the bar-like ridge crosses the neck of the bladder. Such an obstacle exercises nearly the same influence as enlarge-

ment of the middle lobe of the prostate, and what has been said in relation to the latter may be applied to the former.

Chronic inflammation, or catarrh of the bladder, is of very frequent occurrence in calculous patients, and it is therefore of importance to examine how far such a condition may influence our choice of the operation to be selected.

If we were to reason *à priori*, we might readily conclude that the use of lithotritic instruments in a bladder already inflamed must inevitably aggravate the inflammation and give rise to serious accidents ; and hence that catarrh of the bladder is a positive contra-indication of lithotrity. During the early period of his practice, even M. Civiale himself was influenced by this preconceived notion, and rejected all cases in which catarrh of the bladder existed to any extent. Experience soon proved that his fears were unfounded. Simple and mild catarrh of the bladder, instead of being aggravated by lithotrity, is almost always alleviated by comminution of the calculus—I allude, of course, to that form of catarrh which depends on the presence of a foreign body in the bladder.

This fact has been fully established by experience in hundreds of cases, and I do not think it necessary to dwell on it. Indeed, were the fact not so, lithotrity must have been abandoned long ago, for few calculous patients are entirely free from vesical catarrh under some form or another.

It is only where the chronic inflammation of the bladder has been of long standing, or is complicated with other lesions, that it becomes necessary to reflect whe-

ther the state of the vesical mucous membrane be such as will admit of our employing instruments without danger.

Whenever catarrh of the bladder is complicated with any serious disease of the neck or body of the organ, it will be prudent to abstain from lithotrity. The necessary manipulation might in some cases, aggravate the chronic inflammation, and rapidly compromise the life of the patient. I would also abstain from the use of lithotrity in cases where catarrh of the bladder is accompanied by any well-marked signs of irritation, such as pain and difficulty of micturition, a frequent desire to evacuate the bladder, &c.

Purulent catarrh of the bladder is, according to my experience, a very positive contra-indication to lithotrity. It is not so much that the presence of pus in the urine denotes an advanced degree of inflammation in the mucous membrane, but from the fact that purulent secretion from any portion of the urinary system becomes a determining cause of purulent infection under the influence of lithotrity. The pus contained in the urine may be derived not only from the inflamed mucous lining of the bladder, but from the surface of a cyst, from the ureters, from the pelvis of the kidney, or from the kidneys themselves ; in all these latter cases, purulent infection is liable to supervene, and this complication is almost inevitably fatal.

When catarrh of the bladder exists, we must, therefore, take into account its nature and its degree. If not very severe. and if unaccompanied by any serious organic lesion, it does not contra-indicate lithotrity. Still, experience teaches us that certain precautions must be

observed to prevent the chance of failure or the occurrence of secondary accidents. The calculus must be a small one, unless it be phosphatic, which species is rapidly crushed. The operations or sittings, as they are technically called, must be short, and great care must be taken to relieve the bladder of detritus by frequent injections of tepid water. The principle we have to look to, in short, is to avoid anything which may aggravate beyond measure the irritation which already exists; and if this principle be adhered to, the catarrh will gradually subside with the expulsion of the fragments, instead of being increased by the operation.

Another condition of the bladder which frequently exists in old or severe cases of stone, and which contra-indicates lithotrity, is hypertrophy of the organ, with diminution of its cavity, and excessive irritability. Here I may repeat what I said relative to one of the conditions essential for successful lithotrity, and it will be seen at once why the state of the bladder just mentioned is a contra-indication: 'The play of the instruments in the bladder must be sufficiently free to allow of our crushing the stone without inflicting any injury on the walls of the bladder, or irritating that organ in any dangerous degree.' Now this condition evidently cannot be attained whenever the walls of the bladder are hypertrophied so as to give great force to their contractions, and so irritable that they contract on the slightest stimulus, firmly grasping the stone, and resisting the introduction of a few ounces of fluid. It were manifest folly to attempt an operation under circumstances which are diametrically opposed to it. The existence of a certain space between the walls of the

bladder and the surface of the calculus, is necessary for the safe performance of lithotrity. This space is filled with fluid to keep the walls of the bladder permanently out of the way of the instrument, and prevent any injury from friction. When the hypertrophied bladder closely grasps the stone, as the French say, like a "night-cap," and is at the same time irritable, no space can be obtained, no fluid is retained in the bladder; if we operate, we do so without the protection of a fluid medium, and no prudent surgeon would undertake the risk of such a proceeding.

Hypertrophy of the bladder is often accompanied by abnormal development of the muscular fibres at certain points, which stand out in bundles, like the fleshy columns of the heart, giving the bladder the appearance denominated *vessie à colonnes*. Although this state may present some obstacle to lithotrity, it is not a positive contra-indication;—but it will be more convenient to examine the lesion in connexion with cysts or sacs in the bladder.

CHAPTER IX.

INDICATIONS AND CONTRA-INDICATIONS OF LITHOTRITY.

THE various conditions of the bladder naturally exercise a very great influence over the results of lithotrity. It requires no reasoning to prove that there must be an immense difference between breaking up a calculus in a healthy bladder and in one whose textures and sensibility have been altered by disease. In a certain condition of the bladder, the muscular fibres

Fig. 62.

Fig. 62.—Hypertrophy of the muscular tissue of a portion of the bladder.

are abnormally developed. The hypertrophy of the muscular tissue is sometimes general; in other cases it is confined to particular fibres, which appear to be collected together in bundles, and form fleshy columns somewhat similar to those of the heart. This constitutes the state which French writers have called "vessie à colonnes."

Fig. 63.

Fig. 63.—Hypertrophied and sacculated bladder; one of the cysts to the right contains three calculi.

The frequent and powerful contractions of the bladder often give rise to another morbid condition connected with the one I have just mentioned. In the intervals of the muscular bundles, the mucous wall of the bladder is weak and unsupported; it may yield during the contractions of the bladder, and form

pouches of various kinds, which have been denominated cysts or sacs. A bladder in this condition is said to be "sacculated," and when the calculus is enclosed in one of these sacs, we term the case one of encysted stone.

Fig. 64.

Fig. 64 represents a bladder with three cysts.*

Let me now examine in what manner a columnar state of the bladder and encysted calculus affect the indications of lithotrity. The majority of surgeons are of opinion that lithotrity should be rejected for all cases of hypertrophy of the bladder with irregular development of the muscular fibres. It has been alleged that the projecting and irregular bundles might be readily pinched between the blades of the instrument,

* I am indebted to the kindness of my colleague, Mr. Lane, for this drawing; the preparation is in his museum.

Fig. 65.

Fig. 65.—Back view of the bladder with three cysts.

and that the fragments become entangled in the fibrous network, thus rendering their removal from the bladder difficult, and increasing the danger of relapse. For my own part, I should be inclined to adopt the opinion of M. Blandin, and many other eminent surgeons, and prefer lithotomy in cases of stone complicated with columnar hypertrophy of the bladder; but I must at the same time state that the extensive experience of M. Civiale has led him to a different conclusion. According to him, this condition of the bladder does not contra-indicate lithotrity, but should only render us more cautious while endeavouring to seize the stone or comminute the fragments. It is a very common state in calculous patients; and this we are prepared to admit, on considering how often powerful contractions

of the bladder are excited by the presence of a foreign body. M. Civiale has operated on many patients affected with columnar hypertrophy of the bladder, and the cases have terminated favourably.

The sacculated condition of the bladder is a much more unfavourable circumstance. The sacs or cysts usually occupy the floor of the organ, but they may exist at any point. They are often single, and of considerable size; in other cases, they are small and numerous; the orifice of the sac may be wide, or it may be contracted; the urine often stagnates in these cysts, becomes fœtid, and gives rise to purulent inflammation of their walls, or to the deposit of calculous matter. But the chief point which concerns the operator is to determine whether or not the foreign body be enclosed in the cyst; that is to say, whether the calculus be really encysted or not.

Encysted calculus is a positive contra-indication of lithotrity. It were useless, to say nothing else, to seek in the bladder a foreign body which we cannot seize. Lithotomy is equally inapplicable to such unfortunate cases; attempts have often been made to afford relief by the knife, and by crushing instruments; but the results have not been such as should encourage a prudent surgeon to repeat experiments that almost inevitably hasten death. There is only one case in which any attempt at lithotrity appears to be at all justifiable. In some rare instances, the abnormal position of the calculus is not permanent. The orifice of the sac is wide, and the stone small. Here the foreign body at one time remains within the sac, and at another may be detected free in the cavity of the bladder, having

escaped from its place of concealment. The stone, in fact, then ceases to be encysted, and lithotrity ceases to be inapplicable. Some surgeons recommend us, at all events, to endeavour to remove that portion of the calculus which may project into the bladder beyond the neck of the sac. This has been done; but the relief is very partial, and the risk great. My own opinion is, that we should not meddle in any way with an encysted calculus; the sufferings of the patient are often moderate, and life may be prolonged for a considerable time if we abstain from operating.

Tumours of various kinds are occasionally met with in the bladder of calculous patients. True fibrous cancer, originating in the tissues of the organ, is, according to my experience, excessively rare; I have never yet met with an example of the kind. Simple polypous tumour may also present itself; this form is likewise rare. Dr. Baillie says that he has seen only one case of polypus growing from the internal surface of the bladder. The growth most commonly met with is the one known as medullary fungus or fungus hæmatodes, the nature and appearances of which I need not describe. These tumours usually occupy the neck of the bladder, but they may grow from other parts; they are sometimes covered with calcareous incrustations, and sometimes the calculus itself seems to grow into their interstices.

The diagnosis of fungous tumours of the bladder is not easily made at an early period; and even when the surgeon has succeeded in determining the existence of such a growth, he still finds great difficulty in obtaining any precise knowledge of its seat, form, size, or mode of attachment to the bladder.

Fig. 66.

Fig. 66.—Fungoid tumours of the bladder, with hypertrophy of the prostate, especially of its middle lobe.

Lithotrity is, I think, contra-indicated in all cases where stone in the bladder is complicated with the growth of a fungoid tumour from the surface of that organ. Nearly every surgeon entertains the same view, yet M. Civiale does not regard the presence of tumours in the bladder as absolutely contra-indicating lithotrity; and on going over the account of his cases, I find no less than eleven in which it is stated that the calculous affection was complicated with tumours or fungoid growths from the bladder, yet the cases terminated favourably. M. Civiale sometimes extirpates the growth before he begins the operation; sometimes crushes the stone in the first instance, the size of the morbid growth and various other circumstances determining the mode of proceeding; but I shall not enter into any particulars, for I am persuaded that the most prudent course, in the cases now alluded to, is to abstain from lithotrity altogether. M. Civiale does not seem to me to have distinguished

with sufficient care malignant from non-malignant tumours; and it would require so much tact, so great experience, in short, so many qualities, to complete the operation of lithotrity, under the unfavourable circumstances attending fungoid disease of the bladder, that I feel no hesitation in saying—Abstain. This exclusion does not apply to cases of small polypous tumours, if the bladder be otherwise healthy, and the calculus small, and only moderately hard. The difficulty is to distinguish the case.

Paralysis of the bladder has been mentioned by nearly all writers as a condition which renders lithotrity inapplicable. Here some explanation is necessary. True paralysis of the bladder is a positive contra-indication; it generally denotes some serious disease in other parts of the body; it favours the retention of detritus; and what is worse, is attended (if overlooked) by retention of urine, which may give rise to fatal consequences. But the paralysis of the bladder which occurs in calculous patients is of a different kind: in this form, the muscular fibres are rather weakened or indisposed to act, than virtually paralyzed. The organ itself is almost always enlarged in size, and its walls are thinner than natural, while its mucous membrane is the seat of a slow and very insidious inflammation. The condition of the bladder now alluded to does not influence the manual part of the operation; on the contrary, it is rendered more easy, for the cavity in which we have to work is large, and readily contains a considerable quantity of fluid; while the sensibility is diminished and the patient's sufferings are quite insignificant. But if the operation be easy, its results are to be appre-

hended, and it is in connexion with these that the indications are to be considered.

The atonic state of the bladder, which so often complicates stone, had not been well described until the subject was taken up by M. Civiale, and I shall, therefore, not hesitate to avail myself of the information contained in his most recent works. Paralysis of the bladder, in calculous patients, varies much in degree, from slight loss of power to complete annihilation of the contractile force. In the milder forms the patient is able to expel nearly all the fluid contained in his bladder, and the atonic condition does not become manifest until the last portion of the urine is about to be expelled. The next stage is more serious. The bladder is here very sluggish, and allows a great quantity of urine to accumulate before it begins to contract. The urine, indeed, often flows away from mere regurgitation; it is fœtid, and some degree of vesical catarrh usually exists, accompanied by irregular attacks of fever and disturbance of the digestive functions. Finally, in the most severe form, the bladder is completely paralysed, the powers of feeling and contracting being lost altogether.

Calculous atony of the bladder (if I may be allowed to employ a new term), giving rise to retention of urine, should be carefully distinguished from those causes of retention connected with spasmodic contraction near the neck of the bladder, enlargement of the prostate, or other mechanical obstacles to the discharge of urine. The principal signs of this condition are to be derived by observing the manner in which fluid is expelled from the bladder, either naturally or with the assistance of the

catheter. The patient seldom feels that pressing desire to pass urine which almost constantly exists in those affected with stone; the discharge of urine is slow and imperfect, and we ascertain, at the same time, by examination, that this does not depend on any obstacle in the urethra or about the neck of the bladder. If we desire the patient to pass urine before us, we will find that the urine, towards the end, comes away drop by drop only, and that the bladder is never completely emptied. The fluid evacuated is often of a deep yellow colour and of fœtid odour. The general signs of calculus are slight, and the patient complains of little inconvenience, yet his constitution is slowly undermined. On passing the catheter, it will be found that the cavity of the bladder is large, and contains a considerable quantity of fluid, but the velocity of the stream through the instrument gradually diminishes, because the bladder does not contract in proportion as it becomes emptied. The increased capacity and diminished sensibility of the bladder are two conditions evidently calculated to facilitate the manual part of the operation, but their results, under such circumstances, are always to be apprehended. The patient continues in an apparently satisfactory state for some time, after which he experiences a desire to pass his urine, but is unable to satisfy it. The desire is not extremely urgent, and the early symptoms connected with the retention of urine may be, and often have been, attributed to the operation. If these symptoms be neglected, and the condition of the bladder overlooked, serious accidents may supervene in a very rapid manner. The latent inflammation of the bladder on which this form of paralysis depends, quickly passes

into an acute or nearly acute stage; the patient has irregular attacks of fever, with general uneasiness, or may fall into a typhoid state, which soon terminates fatally.

Atony of the bladder is not an absolute contra-indication of lithotrity, although many surgeons prefer lithotomy in such cases, under the idea that the cutting operation is better calculated to revive the contractility of the bladder. The following are the rules laid down by M. Civiale:—In all cases of atony, and whenever the bladder is unable to empty itself entirely, the operation of lithotrity should not be commenced, until, by preliminary treatment, as repeated injections, tonics, &c., the condition of the bladder has been greatly improved; until the urine has become clear, has lost its fœtid odour, and is almost entirely discharged by the natural efforts. If this improvement can be obtained, the case is brought within the domain of lithotrity; but the operator must proceed with the utmost caution, and watch his patient most narrowly, for the absence of sensibility in the bladder may throw him off his guard or lead him astray. The operations must be very short, and several injections must be thrown in after each, to promote the discharge of the detritus. Above all, retention of urine must be guarded against, and the catheter frequently introduced to prevent any distention of the bladder. Retention of urine and retention of the detritus are the two accidents most likely to occur from atony of the bladder; and if these can be avoided, the case will do well; but if, in spite of our care, any serious symptoms should set in, lithotrity must be abandoned, and the patient cut without delay.

But it happens much more frequently that the bladder of calculous patients is in a condition directly opposite to the one I have just noticed. The constant irritation kept up by the foreign body increases the sensibility of the urethra, of the neck of the bladder, or of the bladder itself, and this often passes into a morbid state which gives rise to very distressing symptoms. The increased or morbid sensibility of the parts may or may not be accompanied by increased contractility of the bladder. In the former case, the application of lithotrity becomes still more difficult.

The chief point which we have to consider in all cases of increased sensibility of the urinary apparatus, is, whether this state be simply nervous, or whether, as often occurs, it be connected with some organic disease of the parts. Nervous irritability will frequently be under the control of treatment, and may be alleviated, if not entirely removed, by the preliminary measures which I have already pointed out. When this object has been attained, lithotrity becomes indicated, and should be performed; but the surgeon must bear in mind the condition of the parts, and never subject the bladder to long or rough manipulations; hence I should say that lithotrity is contra-indicated even when the irritable condition of the parts has been removed, if the calculus be large and hard—in a word, if any circumstances exist which are calculated to render the operations prolonged, or impede the rapid evacuation of the detritus.

When the increased sensibility of the bladder co-exists with or depends on organic disease, lithotrity is contra-indicated. The operation might, perhaps, be attempted

without much danger in cases where the stone is small and soft; but there is always risk of aggravating the organic disease on account of the morbid sensibility of the parts, and the most prudent course, I believe, will be to abstain from lithotrity altogether. The same cause which produced increased sensibility of the urinary apparatus often increases, at the same time, the tendency of the bladder to contract, and this organ, moreover, may be in a state of hypertrophy. The union of these three states, viz., increased sensibility, increased contractility, and hypertrophy of the bladder, is a contra-indication of lithotrity; even the co-existence of any two out of the three renders the case extremely doubtful. Thus, when the urinary organs are highly sensitive, and the bladder has a strong tendency to contract, none but a most practised operator should think of undertaking lithotrity; and even he may soon experience obstacles which will compel him to abandon the attempt. Cases of this kind often present themselves in practice; and the failure which often followed injudicious efforts under such circumstances, was one of the chief causes that brought lithotrity into disrepute at an early period of its career.

The morbid sensibility of the bladder is sometimes accompanied by diminution of its cavity. The bladder is more or less contracted; and, in aggravated cases, its walls are firmly applied over the surface of the calculus, which it seems to hold in a grasp; any fluid injected into the bladder is immediately expelled with force, and all our efforts fail to make it retain even two or three ounces of water. Here lithotrity is manifestly contra-indicated. One of the conditions of the opera-

tion is, that the bladder should contain a certain quantity of fluid, or, in other words, that a certain space should exist between the surface of the calculus and the walls of the bladder. Without such an interval, the movements of the instrument must be extremely limited, and the danger of injuring or exciting the already irritable bladder enormously increased.

Between the extreme cases which I have now pointed out, and those in which lithotrity is clearly indicated, there is a large number of intermediate ones, in which it will require great experience and judgment to decide whether lithotrity be applicable or not. The degrees of sensibility and contractility vary in almost every patient, and many will bear the operation well under circumstances of a very discouraging kind.

It now only remains to examine those indications which relate to certain general points, such as the age of the patient, his state of health, &c. I have already mentioned that I was disposed to exclude from lithotrity all cases of calculus in children under twelve or fifteen years of age. The following are the chief objections against the propriety of applying lithotrity to the young subject. The genito-urinary organs of the child are not fully developed before the age of puberty. The diameter of the urethra is small; the antero-posterior diameter of the bladder is also short; the bladder of children is very irritable, and the neck of this organ is very dilatable—a circumstance which greatly favours the impaction of fragments in the urethra after the stone has been broken up. Finally, the indocility of the child is a great obstacle, and often renders it impossible to manipulate the lithotrite in the

bladder. On the other hand, it is well known that lithotomy is highly successful in children, not more than one in fifteen or twenty dying after the operation when performed on subjects under fourteen years of age. Children then, by almost universal consent, are handed over to the lithotomist.

Certain states of the constitution contra-indicate lithotrity. When patients have suffered from a calculous affection for many years, their general health is often greatly reduced, even though no signs of any severe lesion can be discovered in the bladder or kidneys. The temper becomes extremely irritable; the patient loses flesh; there are frequent febrile attacks; the bladder is contracted, and the desire to pass urine is frequent. In cases of this kind, any attempt at lithotrity would only aggravate the constitutional disturbance, and probably light up fatal disease. Here lithotomy holds out much greater hope of relief.

The kidneys often suffer more or less during the continuance of a calculus in the bladder. This is a fact well known to all practitioners; but in the whole subject of lithotrity there is nothing more difficult to determine than the indications which should be drawn from the existence of renal disease in a patient labouring under stone. The majority of writers lay it down as a principle, that lithotrity should be rejected in all cases complicated with organic disease of the kidneys; while, on the other hand, some affirm that diseases of the kidney, as well as of other organs, are less liable to be aggravated by lithotrity than by lithotomy, the former operation giving an infinitely less shock to the system than the latter. I must confess, however, that I should

be very unwilling to perform lithotrity on a patient in whom unequivocal signs of organic disease of the ureters or kidney had been detected. It is certain that disease of the kidney is the cause of death in a great many of those patients who die after lithotrity; and it has also been proved that the operation is very apt to develope or call out latent disorder of the secreting organs, and at all events render the disease more rapidly fatal than it would have been. Whether, as M. Civiale asserts, lithotomy has not a greater tendency to exasperate the existing lesion of the kidneys, is a question very difficult to determine, yet on this point depends our choice between the two operations. If we are to select lithotrity, it should, in my opinion, be only when the renal disease is not very far advanced, and where the condition of the bladder and nature of the calculus lead us to conclude that the operation may be completed within a short period.

CHAPTER X.

HISTORY OF LITHOTOMY.

In the following chapter I propose pursuing the same plan as the one I adopted for lithotrity. A brief historical sketch will be succeeded by an account of the obstacles which the surgeon may have to encounter during the performance of lithotomy, and of the accidents to which the operation may give rise. This plan will enable me to attain, better than any other, the principal object which I have in view, viz., that of giving a clear account of the relative advantages and disadvantages of the two operations. As the history of lithotomy is much better known than that of lithotrity, I shall not dwell long on it ; and for convenience sake I shall connect the history of each method of performing lithotomy with the description of the particular operation.

Although at the present day nearly all surgeons, both here and in other countries, are agreed on the superiority of the lateral method, and follow it as a general rule, it took many, many centuries before we arrived at this degree of simplicity and perfection ;

and the various methods through which the operation has passed, from the time of Hippocrates to the present day, are almost innumerable. To avoid confusion, I must abandon the chronological order, and adopt one more suited for an explanation of the subject.

The division often employed is based upon the external incision, and operations for the stone have accordingly been distinguished into perinæal, hypogastric, and rectal; but it need hardly be observed that it is the *internal* incision, not the external one, which really determines the character of the operation; and hence some modern writers, with whom I agree, arrange the various methods according to the part divided by the internal incision. Taking this for a basis, we have then the vesical, prostatic, and urethral methods; in the first of which the internal incision is confined to the bladder, in the second to the prostate, and in the last to the urethra.

The following tabular classification, drawn up by a modern author, embraces nearly all the various modes of operating which have been recommended or employed in practice :—

Vesical method. Here the bladder is necessarily divided.	*a.* Perineal	.	1. Method of Celsus. 2. Method of Frère Jacques. 3. Method of Foubert.
	b. Rectal	.	Method of Sanson. Sleigh's method.
	c. Hypograstric.		1. Method of Franco. 2. Method of Rousset. 3. Mixed method. 4. The method now employed.
Prostatic method. The incision, when made according to the rule laid down, does not go beyond the prostate.	*a.* Median	.	1. Vacca's method. 2. Sanson's method.
	b. Unilateral	.	1. Franco's. 2. The common lateral method.
	c. Bilateral	.	1. Dupuytren's. 2. Senn's.
	d. Quadrilateral		Vidal de Cassis.

The operation of lithotomy ascends to the earliest period of the history of the healing art. It was practised in the time of Hippocrates; but this celebrated man had such a horror of wounding the bladder, that he made his pupils take an oath that they would never perform lithotomy. We must come down to Celsus before we find any account of the operation, such as it was performed about his time, and from the description given by the Roman author, it has been called Celsus' method; it is also known under the old denomination of "cutting on the gripe," and likewise under the name of the "lesser apparatus," to distinguish it from one in which a great number of instruments was employed.

Celsus' operation was a very simple one. The surgeon introduced the index and middle fingers (well oiled) of the left hand into the rectum, while, with the right hand, he exercised firm pressure on the lower part of the abdomen. The object was to get the stone under command of the fingers, and push it into the neck of the bladder. This done, a lunated incision (*plaga lunata*) was made through the skin, near the anus, and directly down on the neck of the bladder, the extremities of the incision being directed somewhat towards the thighs. In the deepest and narrowest part of this lunated incision a second but transverse incision was made, by which the neck of the bladder was opened until the urine flowed out, and the wound was made a little larger than the stone. This was now pushed into the external wound with the two fingers in the rectum; or if the calculus were large, it was extracted with a hook, or rather with a kind of curved scoop. A scapel was the only instrument used

for the division of the soft parts and the neck of the bladder; but Celsus mentioned that Meges employed a peculiar kind of knife, with a very sharp point and a curved blade, so as to avoid the inconvenience of being obliged to enlarge his incisions.

The first incision in the method of Celsus, appears to have been an oblique one, although its exact direction is not known; the second incision was transverse, and involved the skin, cellular tissue, the transverse muscles of the perinæum, a small part of the lavator ani, the lower and lateral portion of the prostate through its whole thickness, and finally the neck of the bladder.

It is not now the place to examine the merits and demerits of this method, but I may observe that, notwithstanding its numerous defects, it was the only operation for the extraction of stone from the bladder which was practised down to the commencement of the sixteenth century.

The celebrated operator, Frère Jacques, employed this method in the early period of his practice, but he added to the instruments a grooved sound, and a dilator to enlarge the wound when too small.

Foubert also employed what I have called the vesical method. Having filled the bladder with an injection, and introduced the left fore-finger into the rectum, he plunged a trocar, five inches long, and with a groove in its canula, into the skin at about an inch from the anus, and two or three lines from the tuberosity of the ischium. He now pushed the trocar through the triangular space formed by the muscles of the perinæum until he reached the bladder. When the urine was

discharged he withdrew the trocar, while the groove in the canula served to conduct the point of his knife into the bladder; he next divided about an inch and a quarter of this organ, near the neck, and formed his external incision while withdrawing the knife. A gorget, which acted as a dilator, was next passed into the bladder, and served to conduct the finger and forceps. This operation was performed in 1731; it was modified by M. Thomas, of the Bicêtre Hospital, but both methods were soon abandoned.

In Foubert's method the body of the bladder was divided just behind its neck, but the incision was made through the perinæum. From this to the rectal method of M. Sanson there is only a single step. This method, according to Mr. S. Cooper, was first indicated in the 16th century, by a writer under the assumed name of Vegetius, and M. Clot-Bey informed a friend of mine that it has been practised from time immemorial by the Egyptian lithotomists.

Hoffman described it clearly in 1779, and Martin in 1786; it was not, however, until the year 1817 that the writings of M. Sanson brought it into notice in France. M. Sanson performs his recto-vesical operation in two ways. According to the first method, the patient is placed in the usual position, and a staff is introduced into the bladder, the assistant being directed to keep it perfectly vertical. The left fore-finger is now passed deeply into the rectum, and a straight bistoury, with the blade flat on the finger, is passed sufficiently high up (10 or 12 lines) into this gut. The edge is then turned upwards, the point of the bistoury is passed through the anterior wall of the rectum, and

with a single cut as the knife is withdrawn, the external sphincter and the inferior portion of the rectum are divided along the middle line; the lower surface of the prostate is thus exposed. The fore-finger easily distinguishes, through the thin walls of the bladder, the groove of the staff. The point of the bistoury, guided by the nail, is now made to enter the groove just behind the prostate, and the wall of the bladder is divided on the middle line for about an inch in length. Sanson himself abandoned this method as a bad one. The method which he substituted for it was Vacca's. The point of the knife having passed through the wall of the rectum, as in the preceding operation, the handle of the instrument was depressed, and the anterior wall of the rectum, the sphincter ani, and the perinæum were divided from the anus to the bulb. The prostate was now exposed, and in front of it the operator felt for the groove of the catheter in the membranous part of the urethra; he then inserted the blunt end of the bistoury in the groove at this part, and raising the staff a little he passed the bistoury forwards until its point was just beyond the neck of the bladder. The handle of the bistoury was now lowered, and the prostate was divided directly downwards on the median line. This incision did not go beyond the limits of the gland, or touch the incision already made in the intestine. To avoid the inconveniences which might arise from a division of the sphincter ani, Mr. Sleigh proposed dilating the sphincter and rectum with Weiss's dilator, and making the incision higher up into the bladder, in the space bounded by the vasa deferentia and vesiculæ seminales laterally, by the prostate inferiorly, and by the cul-de-

sac of the peritonæum superiorly; Mr. Sleigh divided the walls of the rectum and bladder with a convex scalpel, concealed in a spring sheath; but in carrying the incision too high, we run the risk of wounding the peritonæum, and this objection has been fatal to the adoption of Mr. Sleigh's proposal. The latter operations of M. Sanson belong rather to the prostatic class than to the vesical. Vacca Berlinghieri may be considered as the author of the pure prostatic method; Marechal and Mery, in endeavouring to improve the "apparatus major," were accustomed to incise the prostate inferiorly as well as laterally. This may have suggested to the Italian surgeon the idea of his median prostatic operation, which consisted in cutting down on the membranous portion of the urethra along the median line of the perinæum, passing a button-headed bistoury into the groove of the staff, and dividing the whole of the lower segment of the prostate along the median line, together with the neck of the bladder, and membranous part of the urethra, if thought requisite.

The first idea of a bilateral operation—that is to say, one in which the right and left segments of the prostate are divided—appears to belong to Le Dran. In performing the lateral operation, Le Dran sometimes found that his internal incision was not sufficiently free. To remedy this inconvenience, he was in the habit of employing a peculiar knife, the blade of which was concealed in its sheath, something like the "lithotome caché." This blade he conducted into the wound along the index-finger of the left hand, and, turning the cutting edge away from him, he divided the right side of

the prostate, thus making a double incision of that organ.

Fig. 66*a*.

Fig. 66*a*.—Le Dran's knife.

Dr. Physick, of the United States, also made a double incision of the prostate in 1804. Sir A. Cooper sometimes adopted the same practice, and many other surgeons have followed the example. The operations however, resembled the bilateral method only so far as the double incision of the prostate went.

The first description of the true method is due to Chaussier, and was published in a thesis of Morand, in 1805. Nine years afterwards Beclard brought forward the method as a new one of his own invention, yet it is remarkable that neither Chaussier, Ribes, nor Beclard, ever performed the operation on the living subject. Dupuytren came after these surgeons, and, after numerous trials, established the operation in 1824. The patient is placed in the same position as for the lateral operation, an assistant holding the staff in an exactly vertical direction. The surgeon keeps the integuments tense with the fingers of his left hand, and, with a double-edged knife, makes a semilunar incision in front of the anus. This incision commences on the right side, between the anus and right ischium, ascends towards the raphé, and terminates on the left side, on a level with the point whence it set out. The middle point of the semilunar incision should traverse the

raphé about ten lines in front of the anus, as in this woodcut, Fig. 67.

Fig. 67.

Fig. 67.—External incision in the bilateral operation of Dupuytren.

It involves the skin, the superficial perinæal fascia, and the anterior fibres of the external sphincter ani. The left fore-finger is now passed into the wound, and guides the knife during a second incision, which lays bare the membranous portion of the urethra; the nail now guides the point of the knife into the groove of the staff at this part, and the membranous portion is opened transversely to the extent of two or three lines, in order to avoid any danger of wounding the rectum. The extremity of the double lithotome (*vide* Fig. 79) is next introduced into the groove of the staff through the small incision alluded to, with its convexity turned towards the rectum; and once fixed in the groove, it is pushed on into the bladder. The staff is now withdrawn, and the lithotome turned so as to present the concavity downwards, the blades are opened, and the instrument withdrawn in a perfectly horizontal direction. The parts divided in this second stage of

operation are the membranous portion of the urethra along the median line, the prostate, and the neck of the bladder, on both sides, in a nearly transverse direction, and to an extent proportioned to the separation of the blades of the lithotome. Dupuytren's method was subsequently modified by M. Senn and Beclard. The former divided the prostate obliquely downwards, as in the lateral operation, during his first incision, while the second incision divided the gland transversely across. Beclard sometimes used a double-cutting gorget, at other times he operated in a way very similar to that of M. Senn; sometimes, indeed, in addition to the incision of the prostate, he divided the neck of the bladder to the right and left. M. Maisonneuve endeavoured to introduce an ingenious modification of the bilateral method. Having introduced a grooved staff in the usual way, he passed the left forefinger into the rectum, and along it the flat side of a straight bistoury. When the point of the bistoury had been introduced about three-quarters of an inch beyond the margin of the anus, its cutting edge was directed forwards, and, by depressing the handle, the point was made to divide the anterior wall of the rectum and the posterior part of the bladder, down to the upper edge of the sphincter ani; a double lithotome was now passed into the neck of the bladder and prostatic portion of the urethra, and the prostate divided. This done the lithotome was withdrawn, and the forceps introduced through the rectum. This operation was performed once, I believe, in 1847, but the patient remained afflicted with recto-vesical fistula.

The quadrilateral method of M. Vidal de Cassis may be here noticed, rather as a matter of history than a

subject of instruction. It was proposed in 1828, on the principle that the size of the calculus should give rise to a multiplicity of incisions—not to an excessive single one. M. Vidal commonly makes his first incision transversely, in the same way as Dupuytren. When the calculus is large, he divides the prostate obliquely downwards and outwards, on both sides, with a knife; if the stone be very large, he introduces the left index-finger into the bottom of the wound, passes along it the flat side of a long button-headed bistoury; he then divides the prostate obliquely upwards, and to the left, and also obliquely upwards to the right (in the manner illustrated by the accompanying drawing, Fig. 68.) This

Fig. 68.

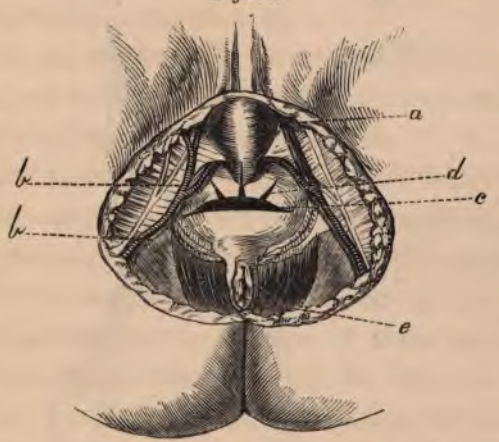

Fig. 68.—The quadrilateral operation of M. Vidal de Cassis: *a*, bulb of the urethra, below which is seen an internal incision, descending perpendicularly; *b b*, the arteries and veins of the perinæum; *c*, a semilunar transverse incision, dividing the prostate across; *d*, an ascending incision, which is repeated on opposite side; *e*, the anus.

method has had few partisans in France, and none that I am aware of in other countries.

The apparatus major, so called from the number of instruments employed, was invented by Johannes de Romanis, about the year 1520; an account of it was published soon afterwards by his pupil, Marianus Sanctus; hence it is also known as the Marian method. The principle of this method seems to be that of dilating the incision in the urethra, instead of freely dividing the parts. The external incision was made along the raphé, or to one side of it, and extended from the bottom of the scrotum to within a few lines of the anus—a grooved staff, I should mention, having been first introduced into the bladder. The incision was carried down to the membranous part of the urethra,

Fig. 69. *Fig.* 70.

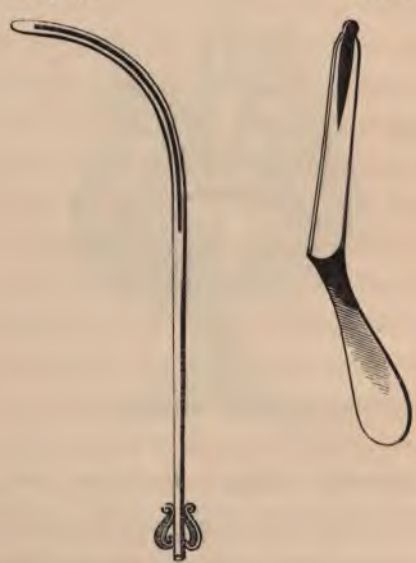

Fig. 69.—Grooved catheter of Marianus.
Fig. 70.—The original gorget of J. de Romanis (1520).

which was also freely divided. Through the latter incision various kinds of instruments were passed into the bladder, for the purpose of dilating—it would be more correct to say lacerating—the original wound. Marianus described a male and female conductor, the branches of which were forcibly separated, until the degree of dilatation supposed to be necessary was attained. This done, forceps were substituted for the conductors, and the calculus extracted.

This method was introduced into France soon after its invention, and thence passed into other countries. It was at first kept secret, but after the publication of Collot's work on Lithotomy, it became extensively known, and for nearly two hundred years all the surgeons in Europe adhered to it.

The Marian method had been abandoned for nearly one hundred years, when Dr. Willis endeavoured to revive it, though with some modifications.

The first steps of the operation are the same as in the lateral operation; but when the membranous part of the urethra has been opened, Dr. Willis advises that dilatation of the prostate and neck of the bladder should be substituted for incision of these parts. The dilatation may be effected with Dr. Arnott's instrument, and continued from twenty-four to forty-eight hours, according to circumstances. If the calculus were very large, Dr. Willis advises us to break it up in the bladder, and then extract it through the dilated passages. Two or three trials of this method have been made; but the results were not very encouraging, and the operation has been abandoned. No method which keeps the patient from twenty-four to forty-eight hours

under operation is likely to receive the sanction of the profession, and still less of the patient.

Practical surgeons, even at a time when anatomy was little, if at all cultivated, were aware that the great size of a calculus formed one of the most formidable obstacles to its successful extraction from the bladder; hence they sought every point at which that organ could be freely divided. I have already alluded to the method of opening the bladder through the rectum, where it was thought a considerable space could be obtained.

The same consideration led to the operation of cutting into the bladder above the pubes an operation which constitutes the high or supra-pubic method. Mr. Samuel Cooper attributes the invention of this method to Germain Collot, who lived under Louis XI., but the operation performed by Collot on the criminal alluded to by Mr. Cooper was generally considered to have been the "apparatus major;" at all events, nothing in the notice given of this operation by Monstrelet, a contemporary writer, would lead to the conclusion that it was the high one.

Franco, in 1556, is the first author who speaks of it in a decisive manner, and who may be regarded as the inventor; but he merely mentions that he cut down on the calculus, above the pubes, in a little boy two years of age, and saved his patient.

In 1581, Rousset gave a most full description of the operation, which differs little from the one practised at the present day, yet he never had an opportunity of performing it on the living subject. From a passage in the letters of the celebrated Gui-Patin, it would ap-

pear that Nicholas Pietré performed the high operation several times previous to the year 1635. In 1693 Proby operated in Dublin by the same method, and published an account of his operations in the *Philosophical Transactions* of 1700. The high method, however, never attracted any notice until it was taken up in England by Dr. Douglas, in 1719, and by his efforts established amongst the received operations of surgery.

Douglas commenced by injecting some fluid into the bladder, a precaution which he borrowed from Rousset. He then divided the walls of the abdomen along the linea alba, commencing at the upper part of the prominence formed by the distended bladder, and going down to the pubes. Having cut until the fluctuation could be distinctly felt, he took a narrow, long, and curved bistoury, and placing the back on the os pubis he directed the point downwards towards the neck of the bladder. Having penetrated this organ, he carried the bistoury rapidly upwards, until the incision was sufficiently long; the calculus was then extracted with the fingers or forceps.

The high operation introduced by Douglas soon attracted much attention, was adopted by many celebrated lithotomists, and underwent several modifications. I shall briefly notice the latter according as they affect the different steps of the operation.

Rousset proposed an incision along the median line, of three to four inches long, between the pyramidal muscles. Cheselden gives the same directions; but Douglas, it would seem, divided the muscular tissue. In order to avoid all danger of wounding the peritonæum,

safety of the operation, they have been rejected as superfluous by Dupuytren and Scarpa. The best method, perhaps, of obviating the danger of urinous infiltration, is to keep a gum-elastic catheter constantly in the wound, and use pressure on the edges of the incision by compresses and a bandage.

The high operation was mainly advocated since the time of Come by the two Souberbielles in France, and by the late Mr. Carpue in England. It flourished for a time, but had soon to give way before the lateral operation of Cheselden, the most perfect of all methods, and the one now adopted in preference to all others. Let us endeavour to follow out the steps of this method from its origin.

The first surgeon who described anything resembling the modern lateral operation was unquestionably Pierre Franco, of Provence. This celebrated surgeon published, in the year 1561, "A Treatise on Hernia, the Stone," &c., in which we find a description of his method of operating for calculus. The passage well deserves being recorded :—

"In the second manner of extracting the stone, the surgeon places his patient in the usual position, and then makes an incision between the fundament and testicles about two or three fingers' breadth on one side of the commissure (raphé) : but previous to this, he must have passed into the bladder a sound, with a groove in it, so that the razor* may follow the groove into the bladder. An assistant takes charge of the sound, and holds it firmly, but he is by no means to press it downwards against the commissure or perinæum. He directs it,

* The old French term for scalpel.

however, a little towards the right side, so that the incision may fall directly on it, and the razor enter the groove more easily. Having introduced the razor into the groove, it is made to divide the neck of the bladder until the cavity is reached; the razor cuts on both sides, and the incision must be proportioned to the supposed size of the stone. The razor is now removed, and a gorget passed in until its point meets the groove; the assistant lowers the handle of the sound, which raises the end of it, and facilitates the entrance of the gorget into the bladder. The gorget is now passed on until its point gets beyond the groove, and is well entered into the bladder. The sound is now withdrawn and the forceps conducted along the large groove of the gorget into the bladder. The gorget is now in its turn withdrawn, and the stone being seized with the forceps, is extracted in the best manner that may."

And in another place, Franco says, "Even when the stone is very large, we must be careful not to cut anything beyond the neck of the bladder."

Here we find many of the principal elements of the lateral operation—the oblique external incision, the grooved staff, and the internal incision confined to the membranous part of the urethra and the prostate.

From Franco, we must pass over fifty years, until we arrive at the time of the equally celebrated Frère Jacques. At the age of sixteen years, Frère Jaques was a dragoon, and made the acquaintance of a quack lithotomist named Pauloni, who served in the same cavalry regiment with him. He worked in company with this man for six years, after which he set up on his own account. In 1690, he assumed a peculiar monkish

Fig. 72. *Fig.* 73. *Fig.* 74.

Fig. 71.

Fig. 71.—Franco's grooved staff.
Fig. 72.—Bistoury of Marianus. Franco's razor was of the same shape.
Fig. 73.—Franco's gorget.
Fig. 74.—Franco's scoop.

dress, and hence was ever afterwards known as "Brother Jacques," though he did not belong to any order. Frère Jacques arrived at Paris in 1697, and there performed several operations; but his first method was extremely defective, and he cut directly into the bladder, without the aid of a grooved staff. In 1700, Mery, a distinguished surgeon of the time, published some critical observations on Jacques's method. The latter received them well, retired to Versailles, and for two years gave himself up exclusively to the study of anatomy and the practice of operations on the dead body. In 1702, he published a short pamphlet, with an account of his improved method, and cut at Versailles,

in presence of the surgeons of La Charité, thirty-eight patients, without losing a single case.

Frère Jacques's second method may be thus briefly described: he passed a grooved staff into the bladder, made an oblique incision from the raphé towards the tuberosity of the ischium, then cut down between the erector penis and accelerator urinæ, until he arrived at the groove of the staff, divided the neck of the bladder in its whole length, and introduced the forceps along his finger.

The operation now described was introduced into Holland by Raw, in 1704, but the precise mode adopted by him is unknown. It was also taken up by Cheselden about the same time, but he did not publish any complete account of his method until 1730. Having introduced a grooved staff into the bladder, the convexity being somewhat turned towards the left side, Cheselden made his first incision, beginning about the spot where the old operation ended, and continued it near to the tuberosity of the ischium. He then cut down between the accelerator urinæ and erector penis, and by the side of the rectum. His next care was to feel for the staff, pressing down the rectum with one or two fingers of the left hand, and he cut upon the instrument in the membranous portion of the urethra, from below upwards, to avoid the gut. A gorget was then passed along the groove of the staff into the bladder, and the forceps over it in the usual way.

From this brief description it may be seen that the operations described by Franco, in 1561, by Frère Jacques, in 1702, and by Cheselden, in 1730, are nearly the same. Their methods, in fact, were identical,

Fig. 75. *Fig.* 76.

Fig. 75.—Cheselden's knife. *Fig.* 76.—Forceps for extracting the stone.

and any changes which have been since made relate more to the manner of executing the operation than to the method itself. The great difficulty in this operation was to make the internal incision exactly of the required size, and this the practised hand of Cheselden executed with great facility. When a moderate incision was required, he merely glided his knife along the groove as far as the neck of the bladder; if the calculus was very large he directed the cutting edge of his knife towards the left side, and divided more or less of the left lobe of the prostate, after the manner of Le Dran.

A great variety of instruments were invented by different surgeons, for the purpose of limiting the internal

incision according to the will of the operator ; but I cannot enter into a description of them, and must confine myself to a notice of two, the lithotome caché and the cutting gorget. The lithotome caché was invented in 1748, by Frère Come, and this instrument is still much employed in France.

The annexed engravings give a sufficiently clear notion of the manner in which the instrument acts. When it is shut, the cutting blade to the right is concealed in the sheath, the point of which is button-shaped, in order to secure its easy passage in the groove of the staff. When the point of the instrument has passed along the groove of the staff into the bladder, the handle is pressed, and the blade then emerges from its sheath. The graduated scale, marked near the hinge by cross lines, shows to what extent the cutting-blade has receded from its sheath, and, consequently, indicates the extent of the incisions which the lithotome will make on being withdrawn from the bladder. Dupuytren, and many eminent French surgeons, consider this a very safe instrument.

The invention of the cutting gorget is due to Sir Cæsar Hawkins, grandfather of the distinguished surgeon of the same name, now connected with St. George's Hospital, and President of the College of Surgeons. Before him Le Cat had imagined a kind of lithotome gorget, which cut on one side, and appears like a combination of Hawkins's gorget with the lithotome caché of Frère Come. The form of Hawkins's first gorget is not very unlike the original instrument of De Romanis (see Fig. 70), but differs from it in having a cutting edge along the right side. This instrument has been vari-

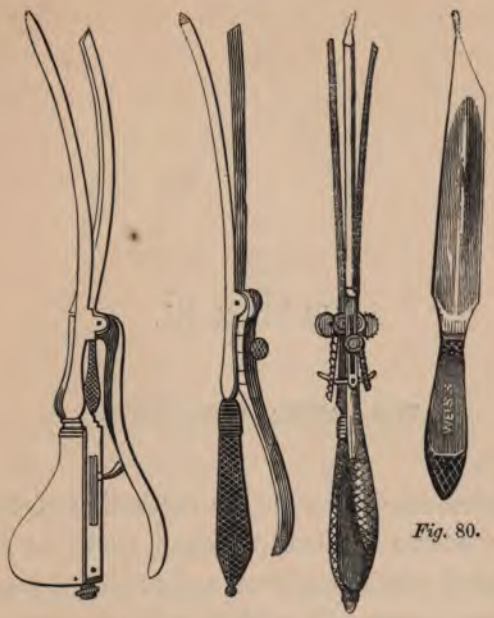

Fig. 77. *Fig.* 78. *Fig.* 79. *Fig.* 80.

Fig. 77.—Frère Come's original lithotome caché (1735).
Fig. 78.—Lithotome caché of Frère Come as it is now used.
Fig. 79.—Dupuytren's double lithotome caché.
Fig. 80.—Hawkins's gorget.

ously modified by B. Bell, Desault, Cline, Cruikshank, Scarpa, and Abernethy, but it were useless to notice these modifications, as, with three or four exceptions—splendid exceptions I admit—the use of the gorget is abandoned.

CHAPTER XI.

THE LATERAL OPERATION.

THE lateral operation for the extraction of stone, invented by Pierre Franco, practised by Frère Jacques, but simplified, much improved, and rendered popular by our own countryman, Cheselden, is the one now resorted to in the great majority of cases. It seems astonishing that it had not been discovered many centuries before; but we should remember, that during the early and middle ages lithotomy was mostly confined to the hands of quack operators; and that anatomy, the only sure basis of surgical operations, was not cultivated until comparatively a recent period of our art. A slight acquaintance, indeed, with anatomy must have conducted the surgeon to the principles of the lateral method. All medical men are now familiar with the anatomy of the perinæum, but a few general points may be noticed with advantage.

From the accompanying sketches it will be at once perceived that the floor of the pelvis may be represented by a triangle. The base of the triangle is marked by a line which runs transversely across the

Fig. 81.

Fig. 81.—Perinæal triangle.

perinæum from one tuber ischium to the other, crossing a little above the margin of the anus. The sides of the triangle, which are of equal length, run obliquely upwards and inwards, from the tuberosities along the erectores penis muscles, until they meet at the apex of the triangle, represented by the under part of the symphysis pubis. If no parts of any importance lay beneath this triangular surface, nothing would be more easy than to cut into the bladder, and extract the stone; but the triangle is divided into two nearly equal parts by the rectum, and hence we have but one-half of it to work in; thus—

Fig. 82.

Fig. 82.—Perinæal triangle divided into two nearly equal parts. The line in the centre of the triangle to the right shows the line of incision in the lateral operation.

or a right-angled triangle, the base of which runs from the margin of the anus to the tuberosity of the ischium, while the perpendicular ascends along the line of the raphé to the angle of the symphysis, or rather to the triangular ligament. Now, if we have a solid body of any size to extract through this triangular space, it is manifest that the line it should follow is the one indicated by the line to the right—that is to say, the line of the lateral incision. This holds good so far at least as the external plane of the triangle is concerned ; but if we take into account the deeper-seated parts, we find that each of the right-angled triangles of which I have spoken, forms a kind of canal, like a truncated prism, which extends from the integuments to the prostate and bladder. This canal ascends obliquely from backwards and upwards ; it is narrow above, but expands as it approaches the anus, and may be considered as terminating with its basis in the fatty cellular tissue which surrounds the lower portion of the rectum. It is along this oblique internal triangle on the left side that the instruments are carried during the lateral operation. The base of the large triangle—that is to say, the distance from one tuberosity to another—is about two inches and three-quarters in the adult ; and the distance from the skin of the perinæum to the neck of the bladder varies from one inch and a half to three inches, or even more when the subject is extremely fat.

For the proper performance of the lateral operation, it is indispensable that the surgeon should possess a clear and accurate knowledge of the anatomy of the perinæum. No man ignorant, or even careless

of such a subject, should take upon himself a responsibility so great as that of cutting into the bladder of a fellow-creature ; he should study the history of the operation of lithotomy, and noting well the causes of its failure in early times, mark how, aided by anatomical knowledge, experienced surgeons have traced, from age to age, what may be most surely effected, and from what source the chief dangers of each step are to be apprehended.

The accompanying sketches (Figs. 83 and 84), from Mr. Erasmus Wilson's work illustrate the relative anatomy of the muscles and arteries of the perinæum.

Fig. 83.

Fig. 83.—The perinæum with the superficial fascia removed. *a*, the accelerator urinæ; *b*, the erector penis; *c*, the transverse muscle; *d*, tuber ischii; *e*, the levator ani; *f*, the coccygeal muscle.

Before being submitted to the lateral operation, the patient should undergo very careful preliminary treatment. This is an important point to which the most successful lithotomists have always been attentive. I am accustomed to clear out the bowels on the night

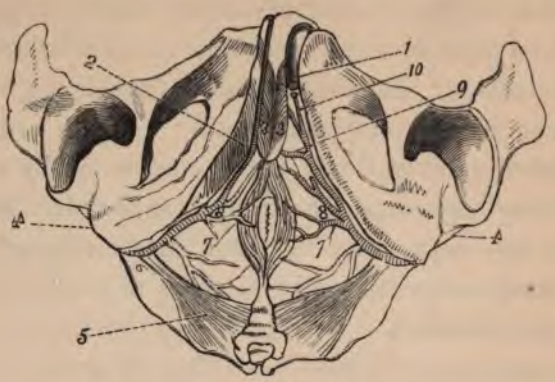

Fig. 84.

Fig. 84.—The arteries of the perinæum. On the right side of the subject are the superficial; on the left side the deep. 1, the left corpus spongiosum: the crus has been removed; 2, the erector muscles; 3 3, acceleratores urinæ; 4 4, tuberosities of ischii; 5, smaller sciatic ligament; 6, the internal pudic artery, crossing the ligament to enter the perinæum; 7 7, hæmorrhoidal arteries; 8 8, the superficial perineal artery, giving off on the right side some transverse branches, and then ascending: on the left side the artery is cut off; 9, the artery of the bulb; 10, the terminal branches of the internal pudic—one going into the divided extremity of the crus penis, the other dipping down to gain the dorsal surface of the penis.

previous to the operation, and to administer two clysters, one in the morning, the other about an hour before the operation. The second injection must, of course, have been expelled before we think of beginning the operation. It will also be necessary, on the previous day, to examine the state of the prostate, and take the measures, if I may use such a term, of the perinæum and pelvic outlet in their various diameters.

The instruments now employed for the lateral operation are few and simple; a straight knife for the external, and a probe-pointed bistoury for the internal incision; a grooved staff, and the forceps for extracting the stone, are all that are essentially requisite; but it will be prudent to have in readiness needles and tenacula for taking

up vessels, canulæ for plugging, and scoops in case the calculus breaks, or cannot be seized by the forceps.

A great deal has been said about the position of the patient. He should be placed evenly on his back, and supported by pillows, on a table of convenient height, about two feet and a half from the ground. Having clearly ascertained the presence of a calculus in the bladder with a sound or with the staff—I prefer the former myself—the surgeon now proceeds to prepare his patient by having the hands and feet firmly bound together, chloroform having been previously administered.

The operation is made up of several parts or acts which succeed each other in a given order. These are the introduction of the staff, the external incision, the division of the membranous portion of the urethra, the division of the prostate, and, finally, the extraction of the stone.

Let us describe each of these steps in order. The use of a grooved staff for conducting the cutting instrument during the internal incision, was an immense improvement in lithotomy, De Romanis, I believe, was the first who employed it, and his instrument does not differ much from the one now commonly employed. The staff should be full-sized, sufficiently long and curved to enable the point to enter fairly into the bladder. Le Dran, Poteau, and in our own time, Mr. Aston Key, proposed a straight staff, because the point of the knife slips more easily along the straight groove. The groove in the staff should be as deep as is consistent with the solidity of the instrument; it is made either to one side, or along the convexity of the curve,

Fig. 85.

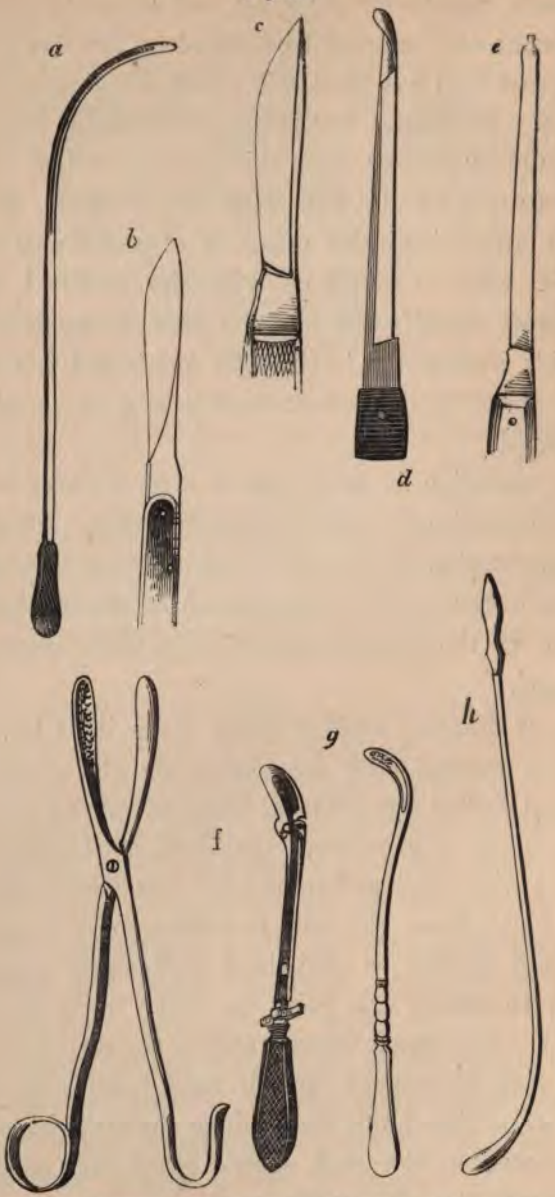

Fig. 85.— Modern Instruments. *a*, Staff. *b*, Liston's knife. *c*, Coulson's knife. *d*, Blizard's knife. *e*, Coulson's straight button-pointed bistoury. *f*, Forceps. *g*, Scoops. *h*, Searcher.

and should cease about a quarter of an inch from the extremity, in order to prevent the knife from passing too far into the bladder. The staff is intrusted to an assistant, who is directed to hold it firmly with the handle in the vertical direction, and the plane of the instrument in the middle line. Many surgeons advise us to direct the handle gently to the right side, so as to make the convexity project slightly on the left side of the perinæum, and act as a guide during the first incisions. Deschamps also gives the same advice, because the inclination of the staff removes the urethra from the rectum. My own experience, however, inclines me to affirm that there is no necessity either of pressing the convexity of the staff down on the middle line of the perinæum, or of directing it towards the left ischium.

The direction of the instrument should, on the contrary, correspond as closely as possible to the natural curve of the urethra; and the staff should be held in such a manner, during the course of the operation, as not to alter a single natural relation of parts. Dr. A. Buchanan, of Glasgow, has substituted a staff, with a rectangular bend in it, instead of the ordinary curved staff. The angle is situate about three inches from the extremity of the staff, and makes a very prominent projection in the perinæum, on which the operator cuts down with facility. The straight extremity of the staff also conducts the knife or bistoury readily into the bladder.

Having thus fixed the staff, and intrusted it to a proper assistant, the surgeon places the fingers of the left hand on the right buttock, and with the thumb makes the skin of the perinæum tense. In doing so he

must be careful not to draw the skin up too much, because if this were done the superior angle of the wound would fall too low after the completion of the operation, and thus give rise to much inconvenience. With a common scalpel the first incision is now made into the integuments. This should commence three or four lines on the left side of the raphé, about one inch above the anus, and be carried obliquely downwards and outwards, a little below the level of the tuber ischii, and a little nearer to that point than the anus. The length of the incision will depend on the size of the perinæum,

Fig. 86.

Fig. 86.—Position of a patient. Dark line shows the first incision; dotted lines show the bony structures

and, generally speaking, extends in the adult from three to three and a half inches. In children, the first incision should commence according to their age, at five or seven lines above the anus. Deschamps was in the habit of terminating the incision at about an inch from the left border of the anus, and did not often exceed an inch and a half or two inches in length,

except when the calculus was supposed to be large. He inclined the incision eight lines from the anus, and four from the ischium. Other writers advise that the external incision should terminate midway on a line drawn from the tuber ischii to the anus; but I think it may be slightly lateralized without danger and with advantage, —that is to say, carried a few lines rather towards the ischium than the middle point alluded to.

In making the first incision, care must be taken neither to commence too high, under the arch of the pubes, nor too low, near the rectum; and not to carry it too obliquely on the ramus of the ischium. There are several objections against commencing the incision too high; a high incision brings us on the bulb, which may be wounded or its artery divided; it also makes the operator commence his internal incisions too far forwards; hence a greater length of the canal than necessary is divided, and, what is worse still, during extraction, the calculus is brought in an unfavourable position; that is to say, towards the apex of the triangle instead of towards the base. If the incision be commenced too low, the rectum runs great risk of being injured; and by carrying the oblique incision too much towards the left side, especially at the lower part, we encounter the risk of dividing the internal pudic artery as it ascends along the ramus of the ischium, an accident of the most troublesome, if not dangerous, nature, for it is very difficult to secure the vessel in this position.

Some operators, formerly rather than now, were in the habit of cutting on the groove of the staff with a single incision; but, unless the perinæum be extremely shallow, I would not recommend such a

proceeding. On the other hand, we must not grope about or lose valuable time, but, with a few rapid touches of the scalpel, continue the incision on to the staff. In thin persons or children this is very soon found; in others, the finger soon distinguishes the bulb of the urethra, and near to it the convex surface of the staff, as it enters the membranous portion of the urethra. The left index-finger is now passed to the bottom of the wound, the nail soon falls on the groove, and serves to guide the point of the knife on the staff.

The first incision divides successively the integuments, the fatty cellular tissue about the anus, the transverse muscle of the perinæum, the fatty cellular

Fig. 87.

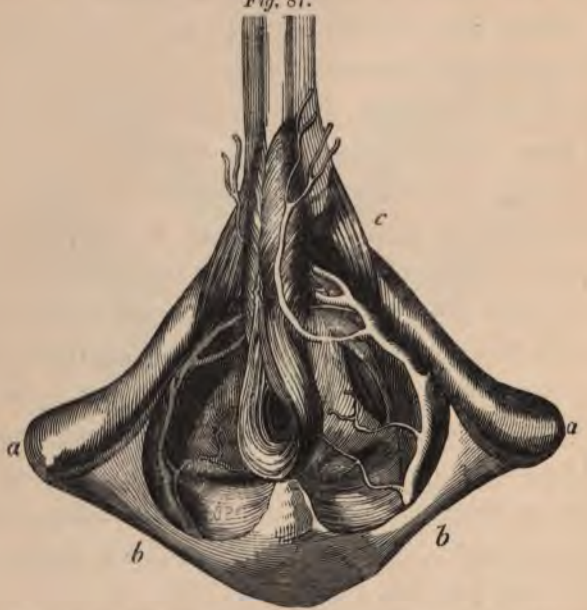

Fig. 87.—View of parts cut in this stage of the operation. *a*, *a*, tuberosities of ischii; *b*, *b*, sacro-sciatic ligaments; the trunk of the internal pudic artery is seen emerging just beyond this line; *c*, erector penis; to the left along the middle line is the superficial artery of the perinæum; just below the origin of this artery is seen the external incision; and the dark line in the centre of this shows the line of incision through the prostate.

layer between the left erector penis and accelerator urinæ muscles, and some fibres of the levator ani muscle. The superficial artery of the perinæum is likewise generally divided. Having distinctly felt with his nail the groove of the staff, and directed the point of the knife along the finger, the surgeon's next care is to open the urethra. Formerly lithotomists were in the habit of making this opening much too far forwards; but since Cheselden's time all are agreed that the bulbous portion should not be divided. The best point to open, perhaps, is as close to the anterior part of the prostate as possible. This was the late Mr. Liston's opinion. Mr. Allen says we should enter the membranous portion of the urethra about half an inch in front of the prostate. Deschamps made his opening in such a manner as to divide eight or ten lines of the membranous portion of the canal. When the point of the knife has once entered the groove, the surgeon should ascertain, by a slight motion of the point from side to side, that it remains in contact with the staff; and directing the edge upwards and inwards, he makes a small incision through the membranous portion of the urethra. The object of this incision is to make an opening for the instrument, which will presently be mentioned. Some operators, following the original example of Cheselden, cut onwards, along the groove of the staff into the bladder with the same knife which served to make the first incision. Mr. Liston used commonly to operate in this way, and it is at once elegant, simple, and expeditious; but it is not always easy to keep the point of the knife perfectly in contact with the groove of the curved staff. Hence the practice often adopted in this

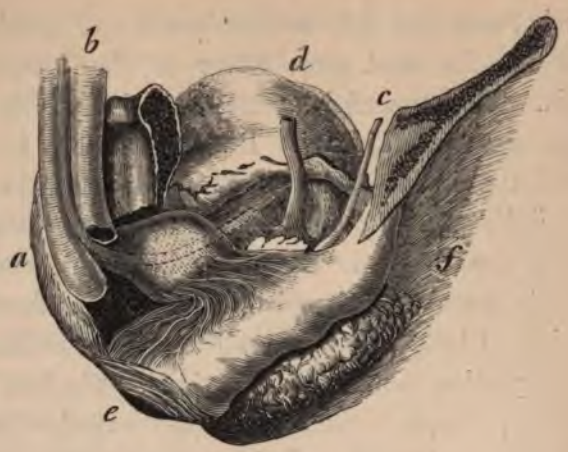

Fig. 88.

Fig. 88.—Side view of the pelvis. The dotted lines show the staff passing through the prostate. *a*, the bulb of the urethra; *b*, corpus cavernosum; *c*, vas deferens; *d*, the ureter, *e*, anus; *f*, rectum.

country and abroad, of completing the internal incision with a button-headed bistoury. It is the safest method, and the one which I generally follow in my own practice.

I cannot exactly say who was the inventor of the button-headed bistoury. The first distinct notice I can find of it is in Deschamps; Langenbeck also proposed a button-headed knife, which is much used in Germany, and Mr. Blizard proposed another. Le Dran also appears to have used an instrument of the kind.

Having made his opening into the membranous part of the urethra, and taken care to keep his nail well in the groove, the surgeon abandons the scalpel, and substitutes for it the button-headed bistoury. This he directs along his finger to the groove of the staff, and having fixed the knob in the groove, he passes the knife onwards until it reaches the bladder, dividing a

Fig. 88 *a.*

Fig. 88 *a.*—Deschamps' button-headed bistoury.

small portion of the membranous part of the urethra and the left side of the prostate obliquely, together with some of the anterior fibres of the levator ani muscle.

In making this internal incision, the handle of the knife must be depressed to the lower angle of the wound, while its cutting edge is inclined outwards and downwards, in the line of the external incision, the edge of the knife being kept in such a manner that it never deviates from the angle it would form with the ramus of the ischium. As soon as the knife enters the bladder, a little urine commonly escapes; the knife is now to be withdrawn exactly in the direction of the external wound, after which the incisions may be considered as being completed.

Although the description of this part of the opera-

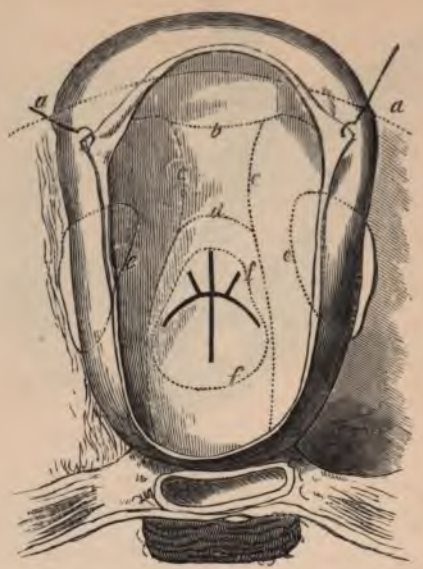

Fig. 89.

Fig. 89.—Bladder opened from behind. *a, a,* the level of the abdomen at lowest part; *b,* the level of symphysis pubis; *c, c,* the descending rami of pubis; *d,* the level of the symphysis inferiorly; *e, e,* the obturator openings; *f, f,* the outline of the prostate. The black lines within this outline show the direction of the internal incision in the various methods of dividing the prostate.

Fig. 90.

Fig. 90.—Front view of the prostate. The lines show the direction of the incisions made in the various ways of dividing this gland.

tion has not been long, and though nothing appears more simple than to divide the prostate with a knife

running along the groove of a staff which guides it in a sure manner, yet this internal incision is the most essential part of lithotomy, and the success of the operation will mainly depend on its being effected in a proper manner.

A few words on this point may be useful. From the moment lithotomy began to take rank as a scientific operation, and was transferred from the hands of quacks to the great masters of our art, the following question was debated, and still occupies attention: "Should the internal incision be carried freely through the prostate and neck of the bladder, or are moderate incisions with subsequent dilatation, to be preferred?"

Fig. 91.

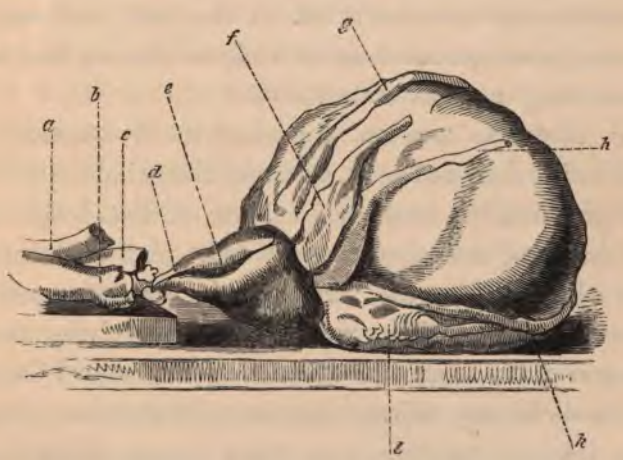

Fig. 91 represents the left lobe of the prostate as it is divided in the lateral operation (Scarpa); *a*, *c*, crura penis; *b*, the bulb of the urethra; *d*, *e*, the incision dividing the membranous portion and left lobe of the prostate; *f*, *l*, the vesiculæ seminales; *g*, the ureter of the right side; *h*, *k*, the vasa deferentia.

Upon this disputed point I may mention my own opinion first, after which I shall endeavour to state

fairly the opinions of other surgeons. I have had some —I may say, without presumption, a large—experience in lithotomy, and the result of my experience is, that the incision through the prostate should be free enough to allow of the extraction of the stone without much violence, yet not too free, for fear of hæmorrhage or infiltration of urine into the extra-aponeurotic cellular tissue. I am therefore an advocate for moderate incisions, followed by gentle dilatation during the extraction of the calculus. What I now say applies to cases in which the stone is not very large; when the latter exceeds a certain size, other modes of extraction become necessary. But it is not enough to say that the internal incision should be moderate or should be free; we must endeavour to define what these words mean, otherwise the operator is left in the dark, and may be making a dangerous incision while he fancies that he is proceeding in a moderate manner.

A moderate incision, according to my meaning, is one which does not pass through the whole depth of the prostate, but leaves a few lines of that body, near its base, and the capsule, undivided. A free incision is one which divides the whole of the prostate; and an extremely free incision would be one involving also a portion of the neck of the bladder. Mr. Samuel Cooper, in his dictionary, affirms that most lithotomists prefer a free internal incision—one which passes through the whole of the prostate and part of the neck of the bladder, without touching the body of that organ. This may have been true at the time when Mr. Cooper wrote, but it certainly does not represent the opinion of the best operators at the present day.

Frère Jacques, it would seem, divided the whole of the prostate and a small part of the body of the bladder. It is not easy to say to what extent Cheselden carried his internal incision, but I am inclined to think that it was rather a free one than what I have defined as moderate. Frère Come, Le Dran, Le Cat, Klein, Souberbielle, &c., also employed free incisions.

The inventor of the lateral method, the great Franco, was the first who understood the advantages of a moderate internal incision. "The smaller the incision (says Franco) the better, provided the stone can pass through it; but, on the other hand, it must not be too small, so as to give rise to much violence in the extraction of the stone. *Bref, il est requis de tenir médiocrité.*" One would imagine that another great surgeon of modern times, Sir Astley Cooper, had this passage in his mind when he said, "The longer I practise, the more I am convinced that the smaller the internal wound made in lithotomy the better."

Scarpa has been the principal advocate of moderate internal incisions, and he has been followed in this advice by Sir Astley Cooper, as I have said, by Dupuytren, Callisen, the late Mr. Crosse, of Norwich, Mr. Liston, and by most lithotomists of the present day.

In the standard work of Dr. Gross on the "Urinary Organs," I find it stated that the practice of American surgeons is in strict conformity with the same principle. "The wound," says Professor Gross, "should in no instance extend entirely through the lateral lobe of the prostate gland, on account of the danger of urinary infiltration."

The late Mr. Martineau, who was one of the most

successful lithotomists that ever operated, is supposed by some to have advocated free incisions, while others claim him as a partisan of dilatation. The fact, however is, that Mr. Martineau followed a method peculiar to himself. His first incision was made nearly in the line of the raphé, while his second incision was a double one; he first carried his knife forwards into the bladder in the usual way, and on withdrawing the knife, he made another incision nearly horizontal, towards the ischium. Mr. Martineau does not appear to have divided the capsule of the gland, and it is certain that he employed dilatation with his finger.

Long before the celebrated memoir of Scarpa appeared, Deschamps had examined this disputed question of free and moderate incisions, and resolved it in the manner conformable to the practice of the best operators of the present day. Deschamps insists on the prudence of our never passing beyond the limits of the prostate.

When the stone is more than twenty lines in diameter, the whole thickness of the prostate must be cut, or other methods employed; but for all calculi below twenty lines, Deschamps shows that an incision of eight lines, or three quarters of an inch, is quite sufficient. This is exactly the opinion of the late Mr. Liston, who was a very successful operator for stone. "The internal incision (says Mr. Liston in his 'Practical Surgery') should certainly not extend beyond seven lines from the urethra outwards and downwards; the less that is cut, the greater will be the patient's safety." With proper dilatation, according to Mr. Liston, a stone of from three to nearly five inches in circumference in

one direction, and from four to six in the largest, may be thus removed. When the stone is larger, other means must be had recourse to; but these I shall examine under the head of Obstacles.

The external and internal incisions are now supposed to be completed, and I shall say nothing more respecting them, except that they should be made as near as possible on the same plane ; that is to say, the internal incision should look obliquely downwards and outwards in the same direction as the external wound.

As a sufficient opening has now been made into the bladder, our next business is to introduce the forceps, and extract the stone. This is sometimes a difficult, but always a very delicate part of the operation, for the dilatation of which I have spoken is usually made during the process of extraction.

As the depth of the perinæum varies in different patients, and the calculus may occupy different parts of the bladder, being sometimes hooked above the pubes, it is necessary that the surgeon should be provided with forceps of various lengths and shapes. The one commonly used is shown in the drawing, (Fig. 85, *f*, page 172). It was formerly the custom to pass a blunt gorget into the bladder, and direct the forceps along its concavity; but we now find the left index-finger sufficient to guide it, and we thus get rid of an instrument. The surgeon then passes his left fore-finger into the bladder, and along it he directs the forceps. If the internal incision be not quite free enough, it may be dilated with the finger, according to Mr. Martineau's practice; at all events the forceps will effect a certain degree of dilatation in pass-

ing through the prostate and neck of the bladder, but great care must be taken not to employ any violence during this step. If we proceed a little more slowly, the chances of ultimate success increase in proportion; and after all, the saving our patient's life is the main object we should look to. In many cases the index-finger can touch the stone, and will therefore guide the forceps at once on it. In others we must use the forceps as a sound, directing it in the first instance to that part of the bladder where the stone most probably lies—that is, to the depression behind the prostate.

Having firmly seized the calculus between the blades of the forceps, we proceed to its extraction. Here the important question of dilatation again presents itself. The internal incision is not large enough *per se* to admit of the passage of a moderate-sized stone. The wound in the prostate and the neck of the bladder must therefore be dilated to a certain degree, and this dilatation moreover must be effected with a certain rapidity, for we cannot, or rather ought not to, keep the patient too long on the table. The tact and experience of the operator must here direct him; still any violent tearing of the parts must be scrupulously avoided, for the results would be inevitably fatal. It is here that the advantage of lithotrity is chiefly seen. The lithotomist has never more than vague notions of the size of the stone which he is to extract; yet the extent of his internal incision and the degree of force he is to employ during extraction—that is to say, the two most important points of his operation—must be guided by an element which is imperfectly known to him. It has occurred to me often, that the operation would gain much if the surgeon

were previously to measure the size of the calculus with some convenient instrument ; and I perceive by a report in "The Lancet," that Mr. Bransby Cooper once had recourse to this plan in a doubtful case. Whenever the calculus is of a flat shape, the operator must endeavour to seize it by its smallest diameter ; and if it seems to stick in the neck of the bladder, he must let it go, and endeavour to re-seize it in a more favourable manner. This done, he withdraws the forceps slowly in the direction of the external wound, dilating the parts gradually, and bringing the instrument towards the lower angle of the external wound in a sweeping direction, so as to follow the axis of the pelvis. The various obstacles which may be encountered during the extraction of the stone will be explained in another chapter.

When the calculus is small, it often escapes from the blades of the forceps. In such cases, recourse is often had to the scoop ; but this is seldom necessary, unless the stone should happen to break into fragments ; and hence, whenever the calculus is of the phosphatic kind, the operator must be careful not to grasp it too firmly with the forceps, for fear of crushing it, and performing perinæal lithotrity against his intention.

When the stone has been extracted, the bladder must be carefully examined for any other urinary concretion ; for this purpose a peculiar kind of sound, called a searcher, may be employed with advantage. (See page 172, Fig. 85, letter *h*.)

The above description applies to the lateral operation as it is performed in this country at the present day. The modern French operation is somewhat different. It is a modification of that invented by Frère Come,

and is performed with a peculiar instrument called the lithotome caché. The patient is placed in the same position as with us, but the hands are not bound to the feet. The mode of performing the external incisions, and of opening the urethra, is also the same; but the urethra is opened just behind the bulb; the lithotome

Fig. 92.

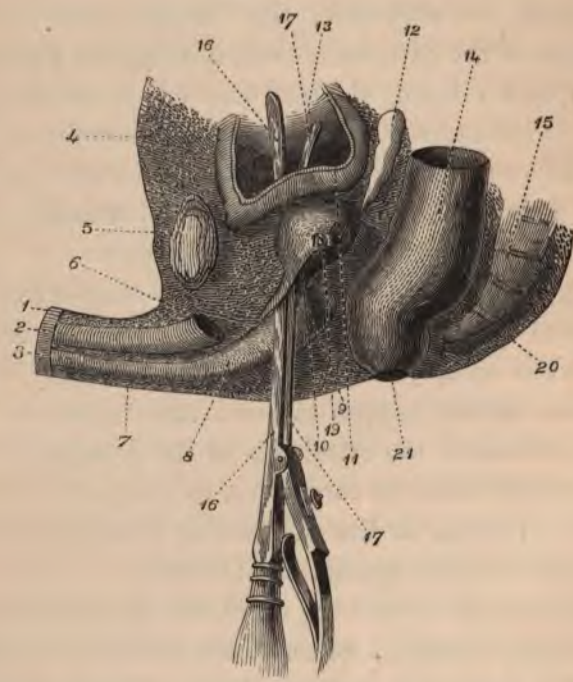

Fig. 92.—Division of the prostate with the lithotome caché. 1, Skin of the penis; 2, corpus cavernosum; 3, spongy portion of the urethra; 4, abdominal parietes; 5, symphysis pubis; 6, posterior attachment of the left corpus cavernosum, cut off from the bone which has been removed; 7, penis; 8, commencement of the bulbous portion of the urethra; 9, bulb; 10, membranous portion of the urethra; 11, bladder; 12, vesiculæ seminales; 13, cavity of the bladder; 14, rectum; 15, sacrum and coccyx; 16, sheath of the lithotome; 17, blade of lithotome; 18, prostate; 19, line indicating the incision made by the lithotome on the left side of the prostate; 20, skin behind the sacrum; 21, anus.

caché is now introduced, and its point fixed in the groove of the staff; it is then passed along the groove into the bladder with the blades closed. When the surgeon conceives that he has passed it sufficiently in, he opens the blades to an extent proportioned to the incision he intends making, and in withdrawing the instrument, which is to be done in a perfectly horizontal manner, he divides the neck of the bladder and prostate in an oblique direction downwards and outwards.

Baron Boyer preferred this instrument to all others; but he employed it in a somewhat different manner. His incision was generally a moderate one, and he preferred dilating it with his finger, or even enlarging it by a second incision, to the risk of cutting too freely. He directed the blade nearly horizontally, and cut towards the ischium until the absence of resistance told him that the prostate was divided across. He then introduced his finger, and dilated the incision downwards, so as to give it somewhat the direction of the external wound.

I should observe that many modern French surgeons employ the blunt-pointed bistoury exactly in the same way we do, but they seem to make their internal incision more freely than we.

CHAPTER XII.

OBSTACLES TO LITHOTOMY.

In describing the obstacles which may present themselves in the performance of lithotomy, and the accidents that may occur during this operation, or follow it more or less rapidly, I shall pursue the same order that I adopted in speaking of lithotrity. The operation for the extraction of stone from the bladder consists, as I have already said of four parts—viz., the introduction of a grooved staff to guide the cutting instrument; the external and internal incisions; and, finally, the extraction of the calculus.

Now, any circumstance which may impede the due performance of one of these successive proceedings becomes an obstacle, and from the latter arise most of the accidents which accompany or succeed the operation of lithotomy. In the present chapter, I shall chiefly confine my remarks to what occurs during the lateral operation, for the accidents, &c., connected with other methods will be noticed in the parallel which I shall draw between them. The introduction of a grooved staff into the bladder, through the urethra, being one of

the conditions or parts of the lateral operation, anything which impedes this step is an obstacle; but I shall not dwell on this circumstance, as it has been already noticed in reference to lithotrity. I shall only remark, that in cases where the calculus is impacted in the neck of the bladder, and cannot be pushed back into the cavity of that organ, it is evidently impossible to introduce the staff, and another method must be had recourse to.

When the patient can be placed in the usual position, and the perinæum is not deformed by tumours, fistulæ, &c., or any irregularity in the bony structures, the operator experiences no difficulty in making the first incisions in a proper manner. On arriving at the membranous portion of the urethra, the point of the knife is generally guided to the groove of the staff without any difficulty; but care must be taken, while we make the opening into this part, not to wound the rectum, which lies close upon it. Hence many operators advise us to open the membranous portion of the urethra from behind forwards; but this precaution has not been found necessary in the practice of English surgeons.

When the internal incision is effected by the same instrument which was employed for the external incisions, there can of course exist no difficulty in hitting upon the small opening made into the membranous portion of the urethra, since the point of the knife has never quitted the groove of the staff. But in this mode of operating there is always some difficulty in making the point of the knife glide regularly and easily along the groove into the bladder. In the hands even of ex-

perienced operators, it has happened that the groove of the staff has been missed, or the knife has slipped out of the groove, making the incision irregularly and to one side, in a dangerous manner. Moreau, Frère Come, Scarpa, and many other writers on lithotomy, mention examples of this accident. On the other hand, when the beaked knife is substituted for the pointed one, there may be some little difficulty in hitting upon the exact point of the urethra, which we have already opened. This, however, is seldom any obstacle, and may be obviated by keeping the nail of the left forefinger well in contact with the groove of the staff, which the assistant takes care to hold perfectly steady.

What has been said shows that there is little or no difficulty in making our way into the bladder; the great difficulty occurs in getting the stone out of that organ, and a variety of obstacles may impede this important part of the operation. Let us examine them in succession. They may arise from certain conditions of the parts, or depend on the nature, position, and size of the calculus.

The foreign body is extracted with a particular kind of forceps, which we pass along the finger through the external and internal incisions, expand in the cavity of the bladder, close over the stone, and then withdraw in the direction of the external wound. During each of these steps the operator may encounter unexpected obstacles. In the first place, the best operators have occasionally found it difficult to seize the stone, although no impediment could be discovered. Mr. Crosse relates a case in which three-

quarters of an hour were spent in efforts to seize a stone not larger than a pigeon's egg.

Generally speaking, however, the nature of the obstacle is sufficiently obvious. Unusual depth of the perinæum, occurring in fat persons, is one. Here the distance from the external surface of the perinæum to the cavity of the bladder is greatly increased; the operator is deprived of the great advantage arising from his being able to examine the interior of the bladder with his finger, and the young operator may be lead astray, imagining that the forceps has gained the vesical cavity when it has hardly reached its entrance. This commonly occurs in old and fat persons; but the same effect, though from a totally different cause, may be observed in the young subject. In children, from the great extensibility of parts, and other circumstances, the bladder is very apt to yield before the knife; and when the incisions have been made, the bladder has also a tendency to recede before the finger. This receding of the organ produces the same effect as if the perinæum were deep, and may become, though not in so great a degree, an obstacle to the easy extraction of the calculus. On the other hand, the neck of the bladder is often thick and unyielding in old persons, offering great impediment to the introduction of the forceps, and a still greater obstacle to their withdrawal. Spasmodic contraction about the neck of the bladder may give rise to the same results; indeed, Deschamps relates an interesting case, where spasmodic contraction rendered it impossible to pass even a catheter into the bladder through the internal incision, which had been freely made with a lithotome caché.

Enlargement of the prostate presents a greater or less obstacle to the easy performance of lithotomy as well as lithotrity. A moderate degree of enlargement may not embarrass the operator ; but when this gland is considerably increased in size, it is always a cause of difficulty and annoyance. Anything approaching scirrhous induration will of course impede the action of the cutting instrument ; and the lithotome caché has been broken in attempts to cut through indurated prostates. But the great obstacle which considerable enlargement of the prostate causes, is to seizing the stone. It places the calculus beyond the reach of the finger, and a sure guide to the position of the foreign body in the bladder is thus lost ; while the distance of the vesical cavity from the external surface is greatly increased. Besides this, the enlarged gland, raising up with it the neck of the bladder, leaves behind it a depression or artificial cavity, in which the stone becomes lodged, and easily escapes being detected by the sound, or seized with the forceps. The instrument slides over the calculus, and the only way of overcoming the difficulty is to employ a very long curved forceps, while, with the finger introduced into the rectum, we endeavour to raise up the stone from the depression behind the prostate in which it is lodged. But enlargement of the middle lobe, if carried to any excess, renders this latter proceeding generally impossible. The finger cannot reach beyond the enlarged lobe.

Several morbid conditions of the bladder itself, may impede the operator in his attempts to seize the stone. These I fully described in the chapter on the Pathological Effects of Vesical Calculi, and they readily ex-

plain the difficulties which are experienced. In old cases of vesical calculi the bladder is often hypertrophied, and at the same time contracted, firmly embracing the stone, or leaving but a small interval between the foreign body and the walls of the containing cavity. The bladder, also, in cases of this kind is often extremely irritable. This condition of the bladder is a source of great embarrassment during the extraction of the stone. When the bladder is closely applied on the surface of a large calculus, it will require all the dexterity and patience of an experienced operator to pass the blades of the forceps between the bladder and the calculus without injuring or severely irritating the former ; the operation thus becomes protracted, and its dangers proportionately increased. Mr. Samuel Cooper, and many other systematic writers, advise us, under such circumstances, to suspend our efforts for a short time, and wait until the contractions of the bladder have become less violent. This, perhaps, is more prudent than to go on irritating a diseased bladder with useless efforts ; yet it is always a most undesirable thing to suspend such an operation as that of lithotomy.

In some calculous patients the mucous coat of the bladder is relaxed and thrown into folds, behind one of which the calculus, if small, may be concealed, and escape the forceps. Here recourse may be had to the scoop, or the stone may perhaps be dislodged from its position by slowly expanding the blades of a broad forceps in a horizontal direction.

It more often happens, however, that a small calculus gets entangled between the meshes of a columnar bladder, and quite eludes our efforts to seize it with the

forceps. Here, unless we can succeed in dislodging the stone from its position, either with the finger, the scoop, or some analogous instrument, I cannot see what is to be done. If we attempt to extract the foreign body without regard to the position which it occupies, the coats of the bladder must be inevitably lacerated. The position of the calculus in a regular sac or cyst formed by the mucous coat, which has been forced outwards between the muscular fibres, is a still greater obstacle, and one, in my judgment, that is all but insurmountable.

Cases of encysted calculi are fortunately very rare, but when they do occur they present one of the most embarrassing conditions with which the lithotomist can have to deal, for the stone is more or less concealed in a sac, the entrance into which may be much narrower than the fundus. Could it be ascertained with any certainty before an operation has been undertaken, that the stone is actually lodged in one of these sacs, I am decidedly of opinion that lithotomy should not be had recourse to, because it is ten to one that the operation will turn out to have been useless; but when an opening has been made into the bladder, the surgeon is extremely unwilling to remove the patient from the operating table without having made every effort to complete the work which he has begun.

Let us consider, then, the various ways in which surgeons have endeavoured to overcome the difficulty of encysted calculi. Two main points are to be borne in mind. The stone may be completely encysted, and the entrance into the sac may be narrow, or its orifice may be wide, and a portion of the stone project into the bladder. When the stone is completely encysted, I am

decidedly of opinion that no attempt should be made to dislodge it by incision of the neck of the sac. The operation of lithotomy must be left unfinished. However disagreeable this may be to the surgeon, it is better than to hasten the patient's death by attempts which almost invariably prove fatal.

On the other hand, when the calculus is only partially contained in the cyst, and the orifice of the latter does not embrace it tightly, as in Fig. 93, an attempt may be made to complete the operation.

Fig. 93.

Fig. 93.—Unusual position of the calculus.

Various expedients have been resorted to by different surgeons. In one case Collot succeeded in dislodging the stone by changing the position of his patient ; but this must be regarded as a lucky chance on which

others cannot count. In another case, where the orifice of the cyst was wide, Moreau succeeded in grasping and dislodging the stone with the forceps. The best practice is to endeavour to dislodge the calculus with the finger; but unless the cyst be seated near the neck of the bladder, the finger does not penetrate far enough to be of much use. A long probe, or other blunt instrument, may be substituted for it, and careful efforts made to enlarge the orifice of the cyst. In one case Sir B. Brodie succeeded in dilating the neck of the sac with a probe-pointed bistoury; after which he separated the calculus from the cyst with his finger, and was fortunate enough to be able to grasp the stone with a forceps. Other surgeons recommend us to divide the neck of the sac with a bistoury, or with the lithotome caché, but I need hardly say that so dangerous a proceeding should never be employed unless the finger can be made to guide the cutting instrument; and if the finger can reach the cyst, I should much prefer dilating its orifice, if practicable, to cutting it.

Desault invented a peculiar kind of knife, somewhat like a pharyngotome, for this operation; but he can cite only a single case of success; and Deschamps also met with but one case of sacculated stone in his extensive practice. The stone was only partly engaged in the sac, and was extracted with the forceps, though with considerable difficulty. After many failures, Deschamps contrived to seize the projecting part of the stone, and to disengage it from the cyst by gentle rotation with the forceps.

If we trust what is contained in books relative to en-

cysted calculi, the operative proceeding seems easy and simple. Thus, to quote a standard work, we are told—"When there is reason to believe that the stone is encysted, it is advisable to introduce the finger into the bladder, and to rupture the cyst with the nail; or where this is impracticable on account of its great strength and thickness, to divide it with a probe-pointed bistoury, or a knife fashioned like a gum lancet, and furnished with a long handle." Such an off-hand way of describing one of the most delicate proceedings in surgery is well calculated to mislead the young practitioner. It is very easy to say, divide the neck of the sac with a knife, but the difficulty is to do so without danger; and I have little hesitation in affirming, that it would be a most hazardous proceeding to divide the tissues of the bladder at any point which is beyond the reach of the finger; and the latter can seldom penetrate more than half an inch beyond the neck of the bladder in the adult. What I now say applies to the lateral operation.

Fig. 94.

Fig. 94.—Calculus hooked above the pubes.

An irregular position of the stone in the bladder may cause some difficulty in seizing it, and thus protract the operation. The natural position, if I may use the term, is in the most depending part of the floor of the bladder, behind the prostate. In some cases, however, the calculus has been found suspended or hooked, as it were, above the prostate, and behind the symphysis pubis, as shown in the annexed drawing (Fig. 94, page 199). Pressure on the abdomen, just above the pubes, may, perhaps, dislodge it; if not, an effort must be made with a forceps strongly curved. In other cases, but these also are extremely rare, the stone appears to be retained in an anomalous position, by some irregular action of the muscular fibres of the bladder, analogous to the hour-glass contraction of the uterus. A case of this kind occurring during the lateral operation, would be the cause of almost insurmountable difficulty. The action of the finger or knife is here out of the question; and, even if the nature of the case were understood, the efforts to pass the blades of the forceps between the stone and contracted cavity must be extremely injurious. Perhaps the only thing left under such untoward circumstances is the high operation. Every case has proved fatal in which the lateral operation has been applied.

The numbers, form, size, and physical nature of the calculi may very much influence the proceedings necessary for their extraction, and render this part of the operation difficult or protracted.

When due care is exercised, the circumstance that more than one calculus is present in the bladder can seldom have any other unfavourable effect than that of prolonging the operation. A tolerably healthy bladder bears the

contact of instruments well, provided no violence be used. The number of calculi which have been sometimes extracted from the bladder, by the lateral operation, is surprising; but we must remember that in such cases the calculi are usually small in proportion to their number. As many as 200 of these small calculi have been removed by M. Roux and Dupuytren. My friend, Professor Eve, of the United States, removed 117 calculi by the lateral operation, about three years ago, and the patient did well. The case of a woman whose bladder contained 214, is recorded in the "Philosophical Transactions;" and even a still greater number has been discovered in the bladder after death.

It is difficult to form any exact estimate of the proportion of cases in which a number of calculi may exist, but it is certain that in a vast majority, I might say ten times to one, the calculus is single. In twenty-seven cases the late Mr. Liston met with seven in which more than one calculus existed; Klein, the celebrated German lithotomist, met with twelve cases (two to six calculi) in seventy-nine operations of lithotomy. We are indebted, however, for the best table which we possess, to the late Mr. Crosse, of Norwich, who gives a list of 100 fatal cases, in eighty-four of which the calculi were single; in seven, two calculi were found; in six, three; in two, four calculi; and in only one, five. A month ago, I extracted four calculi from a patient. Two of these were round and large, measuring more than an inch and a quarter in the smallest diameter. The other two calculi presented at one part flattened surfaces, as if a portion of the sphere had been cut off. They weighed three ounces and a half. This case did ex-

tremely well; and I may here notice, that the sensation communicated by the sound passing over the four calculi, led me to believe that I had to deal with a single large one. A number of small calculi may be extracted with the forceps; but when the foreign bodies are very small and numerous, the scoop seems the better instrument. It has often been said that the roughness of the stone on its surface, is a sure sign that the bladder contains no other calculi; this, however, is an error which Deschamps pointed out long ago. The first stone extracted may present no sign whatever of the effects of friction, yet the bladder may contain several calculi. Hence the practical rule never to remove the patient until we are convinced, by careful examination, that no other foreign bodies are left behind in the bladder.

When the stone is single, and at the same time small, the operator may experience some difficulty in grasping it with the forceps, on account of the smallness of the body which he seeks to lay hold of, or, when seized, it may easily escape from the forceps. Many operators are in the habit of having recourse to the scoop under such circumstances; for my own part I prefer employing the forceps whenever it is possible. It is not easy to find a very small calculus with the scoop, and repeated scraping of the bladder is apt to excite great irritation, if not inflammation of the organ.

The shape of the stone may occasionally be an obstacle to its easy extraction. The commonest form of vesical calculi is the oval, but sometimes they are more or less flattened; thus, one of the calculi extracted by Vacca was two inches long, one inch and two-thirds broad, and not half an inch thick. M. Civiale has seen

calculi almost as flat as a crown-piece, and our own museums contain many specimens of the same kind. We can easily understand that there may be some difficulty in laying hold of a flat stone with the forceps ; but the great obstacle is to its extraction when it has unfortunately been seized by one of its large diameters. There is a great difference between extracting a body which measures two inches, and a body which measures only half an inch, through the same wound in the prostate. The operator must, then, always bear in mind the possibility of his having seized an irregularly shaped stone by one of its long diameters ; and hence, whenever he finds any difficulty in extracting the stone, his first care must be to let go the calculus without withdrawing the forceps from the bladder, and endeavour to seize the stone in a more favourable manner. This must be done before we think of enlarging the internal wound, of breaking up the foreign body, or having recourse to another mode of extraction. It may be that the calculus is really a large one, and that it has been seized in the best way, but we should give the patient the benefit of the doubt, and before pushing dilatation as far as it will go, see if nothing is to be gained by a change of position. On the other hand, the operator must not let go the stone without sufficient reason, and because of slight resistance to extraction ; a great point is always gained when the calculus is once within the grasp of the forceps, and it may not be so easy to catch it the next time he tries. Whenever the finger can be made to penetrate sufficiently far into the bladder, it will be of great assistance in determining the shape of the stone,

and in placing the latter in a more favourable manner between the blades of the forceps.

Although fracture of the calculus during extraction belongs more properly to accidents, it may be conveniently noticed here, for it likewise presents an obstacle to the rapid completion of the operation. It is a curious fact, that the fracture of the stone may be spontaneous, or, at all events, may occur some time anterior to the operation.

Mr. Crosse has published a case placing this fact beyond doubt. In the bladder of a man seventy years of age, Mr. Crosse found twenty-two calculi, weighing three ounces and a half. These calculi, however, were evidently fragments, and could be put together so as to form three different bodies, one comprising five fragments, the second eight, and the last nine fragments. The primitive calculi were about the size of a pigeon's egg, and composed of uric acid with a small proportion of oxalate of lime. M. Civiale endeavours to explain spontaneous fracture of calculi by the violent contractions of an hypertrophied bladder. It would seem that rough exercise on horseback has also been a determining cause of the fracture; while the admirers of mineral waters do not fail to attribute the disintegration which sometimes occurs during their use to the solvent virtues of the spring. However this may be, we find that calculi may spontaneously break up in the bladder, or be fractured by the forceps; and in either case the operation of extraction is necessarily prolonged; in the latter, indeed, the lithotomist has performed a kind of lithotrity, without intending it.

The surgeon should always endeavour to extract the

calculus entire, for two reasons especially. The first is that a single calculus is more quickly extracted than a number of fragments ; and however writers may insist on the necessity of caution, prudence, &c., it is no less certain, that to perform lithotomy well, it must be performed in the shortest space of time compatible with the safety of the patient. The use of chloroform may perhaps render it less necessary than formerly for the operator to be a quick one ; but even with the aid of this valuable agent, I believe that the old rule holds good—the shorter the patient is under the knife the better. I do not say that we are to sacrifice safety to brilliancy, but that the acme of perfection in the lithotomist is, to do his work safely, and at the same time rapidly. The second reason for avoiding fracture of the calculus is, the possibility of relapse from retention of some fragment in the bladder. After lithotrity the natural passages are open for the discharge of detritus ; but after lithotomy, we cannot keep the external wound open too long without inconvenience and danger,

The chemical nature of the stone will of course mainly influence its tendency to give way under the pressure of the forceps. Hence it is of much importance to ascertain beforehand, as nearly as possible, the composition of the calculus which we are about to extract. Uric acid concretions are the hardest, and the ringing sound which they emit when struck, often suffices to indicate their nature. On the other hand, the triple phosphate is easily broken ; but the most fragile of all is the fusible calculus, which sometimes crumbles into fragments on the slightest pressure. It is necessary to bear these points in mind,

for when we know that the calculus is friable, we shall of course be more careful during its extraction. The forceps employed should be broad-bladed, with the teeth not very long, and the stone must be seized as lightly as possible, care being taken not to increase the pressure as the forceps is being withdrawn through the neck of the bladder and prostate, where the greatest resistance is usually experienced.

In spite of caution, the calculus, however, may give way, and either throw off several fragments, or even break up into a mass resembling mortar. This is an unfavourable accident, for it compels us to introduce instruments frequently into the bladder, and the irritation thus produced has excited such violent contraction of the organ as to render it impossible to finish the operation. When it does occur, any large fragments must be extracted with the forceps, and the smaller ones with the scoop; some will inevitably remain behind, and to remove these injections with tepid water are to be employed and repeated before the wound in the perinæum closes. I once had a case in which more than an hour was employed in removing, with a scoop, the matter of a fusible calculus; still a considerable portion remained, and as I was unwilling to protract the operation any longer, I had the patient removed to bed. At the end of a fortnight I introduced a large catheter through the urethra, and washed out the bladder thoroughly; this brought away a good deal of the friable matter through the wound in the perinæum. The same process was repeated every second day until no more calculous matter came away—that is, for about a fortnight. The patient recovered, and has had no relapse.

When the prostate is much enlarged, this plan may not succeed, as the fluid thrown in by the urethra does not find a ready exit through the incision in the neck of the bladder. In cases of this kind, the best practice is to employ the large-eyed catheter, and wash out the bladder in the way I have already described when speaking of the removal of detritus after lithotrity.

The size of the calculus exercises a most important influence on the results of lithotomy. This has been remarked by all operators. Deschamps, whom I have had so often occasion to cite, observes, that it is an axiom in lithotomy, "that the danger, generally speaking, is in proportion to the size of the stone." This can be readily understood. From the limited space through which the calculus has to pass in the lateral operation, one which exceeds certain dimensions cannot be extracted without either making the internal incision dangerously large, or using a degree of force to obtain dilatation of the parts which is perhaps still more fatal; while very large calculi can never be extracted, even by a combination of free incisions and forcible dilatation, without inflicting such a degree of injury on the soft parts as is necessarily fatal. Now and then, indeed, we hear or read of miraculous escapes; but no prudent surgeon should ever count on a good fortune which does not arrive once in a hundred times.

It may naturally be asked, What is to be considered as a large stone? What a small one? These questions are to be answered by a consideration of the diameters of the spaces through which the calculus is extracted during the lateral operation. These we know with suf-

ficient correctness; but another element is necessary; we should also know the diameters of the foreign body; and by comparing these with the diameters of the perinæum we should obtain all the necessary information. Unfortunately the means hitherto employed for ascertaining the size of calculi while contained in the bladder, are extremely imperfect; and hence the weak point of the lateral method. If the case be at all doubtful, that is to say, if the stone exceed an inch in diameter, we can never tell whether or no we shall be able to finish the operation which we have begun, without having recourse to other means which complicate and protract it.

Common sense must suggest (what all writers mention) that it is highly desirable, before proceeding to operate, to ascertain the nature and size of the foreign body which we are about to extract. But how are we desired to ascertain the size of the calculus? With the sound. And how is this instrument to be employed?

Nothing can be more vague or unsatisfactory than the directions which are given on this point. The operator is desirous of obtaining some knowledge to guide him, whether his internal incision should be confined, as Liston advises, to seven or eight lines, or, as Cooper and others, prolonged to the extent of an inch or more. His guide must be the size of the calculus; and to obtain this knowledge, we are desired to tumble the stone about in the bladder with the end of the sound, and moreover estimate the diameters from the presumed weight of the foreign body. Lithotritists never proceed to work on such imperfect data; and I cannot help suggesting that many errors and sore disappoint-

ments might be avoided, if the lithotomists were to follow the example of lithotritrists, and employ some more certain means of ascertaining the exact size of the calculus in doubtful cases, than the end of the sound can ever afford.

If we consider the diameter of the spaces through which the calculus is extracted in the lateral operation, it will be at once evident, that a few lines, more or less, make the difference between a small stone and a moderate one, between a moderate and a large one. Generally speaking, a lithotomist would call a stone below nine or ten lines in diameter a small one; from ten to fifteen lines a moderate one; from fifteen to twenty lines and above, a large calculus. These estimates are made approximately from a consideration of the diameters of the perinæum, both superficial and deep. When even all the soft parts are removed, a line drawn from one tuberosity of the ischium to the other, immediately in front of the anus, does not exceed two inches and a half; from the tuber ischii to the bottom of the pubic arch, we have three inches and a half; and transversely, on a level with the posterior edge of the prostate, we have a diameter of about one inch and three quarters. When all the soft parts are *in situ*, the distances of course become diminished. The depth of the perinæum, or the distance from the skin to the neck of the bladder, varies in different subjects, but may be estimated on the average at two inches and a quarter; while the distance from the posterior edge of the prostate to the inner surface of the ramus of the pubes—a space which the calculus must traverse in the early part of the operation—does not exceed

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one inch and a quarter to one and a half. We must also remember, that the thickness of the prostate in the adult is about eight or nine lines; and when to this we add other soft parts, it is evident that, even with great pressure, a space not exceeding an inch and three-quarters, or at the most two inches, is all that we can obtain. Beyond this, great violence must be exercised on the neck of the bladder and prostate, which will be forcibly pressed against the rami of the pubes.

Fortunately large calculi are rare. It is the size of the stone which concerns the lithotomist; yet, strange to say, nearly all writers give us the weight of the calculus instead of its diameter, and we are left to guess at the size from the weight, although a large stone may be comparatively light, and *vice versâ*. Even Mr. Crosse, to whom we are indebted for so much valuable information connected with lithotomy, has fallen into this error, and recorded the weights in the Norwich collection instead of the diameters. Of 703 calculi noted in Mr. Crosse's tables, I find that 529 were under one ounce in weight, and therefore may be set down as small; 154 were between one and three ounces, and perhaps of moderate size; while only 20 calculi were large, varying in weight from three to six ounces. Hence, according to this table, a large calculus did not present itself oftener than about once in every 35 cases.

Calculi much larger than those alluded to by Mr. Crosse have occasionally been met with; but their history is rather a matter of curiosity than anything else, if we except, indeed, the instruction afforded by the account of the fearful accidents entailed by attempts

to extract enormous calculi by main force. The largest vesical calculus on record is one said to have been in the possession of the French lithotomist, Morand. It weighed six pounds three ounces. This may be apocryphal; but the one recorded by Deschamps is authentic. This enormous stone, which weighed fifty-one ounces, was extracted after death from the bladder of a poor curate, who died in the hospital of La Charité, Paris, in the year 1690. It was six inches and a half long, and one foot in circumference. Deschamps weighed it after the lapse of a century, and found that it had lost in weight only two ounces and half a drachm. The largest calculus in our collections is the one which the late Mr. Cline attempted to extract from the bladder of Sir William Ogilvie. This calculus was larger than the one mentioned by Deschamps, though not so heavy; it weighed forty-four ounces, and was sixteen inches round one axis by fourteen inches round the other. Finally, Verdier met with a calculus which weighed three pounds three ounces. In all these cases the foreign body was found in the bladder after death, or the unfortunate patient died from the attempts made to extract it. At the present day we can hardly understand how a pupil of John Hunter could ever have harboured the thought of forcing a mass more than a foot in circumference through an incision of the prostate. Yet some successful cases have occurred. One is recorded in the *Philosophical Transactions* (1678, No. 171), where the patient is said to have survived the operation, although the stone weighed thirty-five ounces, having a diameter of four inches, and being six inches long. Here, however, the lateral operation was not the

one employed. Klein extracted with success a stone thirteen ounces in weight, and nearly three inches in diameter. Mr. Hamer, of Norwich, extracted one of fifteen ounces in weight, measuring in its diameters four inches and three-quarters by three inches and a half. This patient also survived, but with incurable infirmities. Lastly, I may cite the well known case of Cheselden, who cut, with success, a patient, from whose bladder he removed a large calculus weighing twelve ounces.

These, however, are exceptional cases. Whenever the calculus exceeds one inch and a half in diameter, there will be difficulty in extracting it ; and we may safely lay it down with a celebrated writer, that no stone exceeding two inches in diameter, or six inches in circumference, can be extracted by the lateral operation in its simple form without the risk of disorganizing the parts through which it is to pass. We have merely to seize between the forceps any oval body, measuring more than six inches in circumference, to have an idea of the space necessary for its extraction. Operations for the removal of very large calculi are nearly always fatal. Bell affirms that not one patient in ten survives when the stone exceeds seven or eight ounces in weight ; but even below this the lateral operation is often fatal, when employed for the extraction of moderately sized calculi. This is clearly shown by the tables of Mr. Crosse, already referred to. When the stone is of moderate size, that is to say, exceeds one ounce but is under two ounces, the mortality is nearly doubled ; a little beyond this moderate weight—that is, from two to three ounces—the mortality increases in a remarkable degree ; it becomes thrice as great as in the former

cases, and nearly six times as great as when the calculi are small. With calculi from three to four ounces in weight, only about one-third of those operated on recovered (four in eleven); from four to six ounces, only nine cases occurred, and of these five proved fatal.

From what I have now said it becomes evident that for the extraction of calculi beyond a certain size, the lateral operation must be modified; in other words, that when the operator finds he cannot extract the stone without employing a dangerous degree of force, he must fall back on other expedients. What are these? They are three, between which the surgeon must select the most eligible, according to the case. He may divide the opposite side of the prostate; this is performing the bilateral operation internally, and the lateral one externally. He may break up the stone in the bladder and extract it in fragments; this is performing perinæal lithotrity under the most unfavourable circumstances. Finally, he may abandon the operation he has commenced, and endeavour to extract the calculus by some more favourable outlet, either above the pubes or through the rectum. Let us examine each of these expedients briefly.

In all modern works on lithotomy it is stated that when the stone cannot be extracted by dilatation of the internal incision, the right lobe of the prostate should be divided so as to obtain an increased space; at least this practice is recommended as one of the methods which may be employed in cases of large calculi. But the manner in which this second incision should be made is not described, nor is it easy to say whether any of these authors who advise it ever had recourse to such a pro-

ceeding in actual practice. Sir Benjamin Brodie says, "In some cases a straight probe-pointed bistoury may be introduced, and an incision made in the opposite or undivided side of the prostate, but this is to be done with the greatest caution." Mr. Samuel Cooper, in his Dictionary, says, "the object may be accomplished with a double-edged gorget, a broad double-edged beaked knife, or with Dupuytren's double bistourie caché, or by dividing the two sides of the gland in succession with the knife altogether." Mr. Liston recommends us to divide the gland nearly across with the knife. Dr. Gross says, that the right lobe of the prostate is to be divided in the same manner and in the same direction as the left.

Le Dran, I believe, was the first lithotomist who proposed this double incision. When he conceived that the division of the left lobe of the prostate was insufficient, he introduced the left forefinger into the wound, and passed along it the blade of a knife, somewhat similar to a pharyngotome, with which he divided the opposite side of the prostate. Deschamps conceives that it is much safer to employ the lithotome caché for that purpose.

The plan which I adopt is this: after the division of the left portion of the prostate and the withdrawal of the staff, I introduce my left forefinger as far as I can into the wound, carry along it the button-headed bistoury, and divide the right side of the gland in the same manner as the left. I have lately had recourse to this proceeding in two cases of large calculi with favourable results. But even this double incision of the prostate does not enable us to gain much beyond half an inch, and hence it often becomes necessary to break up the calcu-

lus in the bladder before it can be extracted. This is a very ancient method, and it is astonishing that it did not lead to the discovery of lithotrity at a much earlier period. Celsus and his followers knew no other means of extracting large calculi. Franco recommended them to be broken with a strong pair of forceps, but he also conceived the idea of drilling the stone, and for this purpose he adopted a drill and canula. Le Cat also took up the same idea; after having perforated the calculus with a drill he introduced an instrument into the hole, and split it open.

Here, then, are various modes of lithotrity, with this difference only from the modern operation, that they were performed through an opening in the perinæum, instead of through the natural passages. Some operators attach much importance to the shape of the crushing forceps; but, if the blades be sufficiently strong, any well-made forceps will crush most urinary concretions, and the operator should always have a variety at hand.

There are, however, many strong objections to this ancient method of reducing large calculi to fragments. It is, as I said before, an operation of lithotrity, performed under the most unfavourable circumstances. When the calculus is very large, and the bladder hypertrophied or strongly contracted on the foreign body, it is nearly, if not quite, as difficult to seize the foreign body with the forceps passed through the prostate, as with the lithotrite introduced through the urethra; and the manipulations are just as likely to excite inflammation of the bladder in the one case as in the other. The necessity of a frequent introduction of the forceps is also

a strong objection; as is likewise the possibility of relapse from retained fragments—an accident much more likely to occur than when the lithotrite is employed, because the forceps can never reduce a hard stone into fine fragments.

The third resource which we have, in cases of very large calculi, is either from the outset to extract it by the rectum or above the pubes; or, if the lateral operation has been commenced, and cannot be completed without danger, to abandon it, and extract the stone by one of the methods just mentioned. Whatever objections—and there are many strong ones—may be opposed to the high and rectal methods, it may still be a question whether they are not less dangerous than the accidents inevitably attending attempts to break up a large and resisting calculus in a probably diseased bladder. We have the authority of Bell for asserting that, not one patient out of ten escapes under such circumstances. The mortality of the supra-pubic method, or of Mr. Sanson's operation, is far from being so high under the same conditions. But the question will be examined in the parallel which I shall hereafter draw.

Having thus noticed the principal obstacles to the performance of lithotomy, let us turn to the accidents which attend or follow the operation. That these are numerous and severe may be concluded from the general fact, that about one-fifth or one-sixth of all patients cut for the stone die; and many very distinguished lithotomists have lost one-third of the adults on whom they operated. Some of these accidents may in part be attributed to the surgeon, although we may fairly conclude that it is occasionally difficult to avoid them, from

the circumstance of their having occurred to the most experienced operators.

When the bladder is strongly contracted on the stone, some of the hypertrophied fibres, or a fold of the mucous membrane, may be pinched between the branches of the forceps during the attempt to seize the calculus. This accident is common to lithotrity and lithotomy, and is to be avoided in the manner which I have described in a former chapter. But the condition of the bladder just alluded to may give rise to a much more serious accident, especially in a case where the calculus is large, and where force has been incautiously used soon after the escape of the urine from the bladder. In a case of this kind, if the forceps be hastily introduced, and forcibly expanded in the bladder this organ may be lacerated. Deschamps relates an instructive case of this kind; but the accident is one of those which should be set down to the account of the surgeon, not to the operation. The same remark will apply to another accident, which can never happen in the hands of a prudent operator. From not introducing the finger or blunt gorget into the internal wound, and thus obtaining a sure guide for the forceps, this instrument has been passed between the rectum and prostate, instead of into the bladder, and the soft parts of the perinæum have been seriously disorganized in consequence.

I have already alluded to severe inflammation of the bladder, which may be excited when, from want of dexterity, or through unavoidable obstacles, the surgeon spends a considerable time in groping about the bladder in search of the stone; but this will come under Cystitis.

Of the other primary accidents, the chief one which remains to be noticed is injury of the rectum ; for hæmorrhage is a subject of so much importance, that I shall take it up separately.

The earlier lithotomists speak a good deal about the danger of wounding the rectum ; this is a rare accident now a days ; and if it was more frequent in former times, this chiefly depended on the direction of the external incision ; still it has happened to good operators. Cheselden confesses that he has wounded the intestine more than once. Deschamps wounded it four times ; and Mr. S. Cooper informs us that he has seen it injured in three or four cases likewise. It is clear that the straight incision of the earlier methods must have exposed the surgeon to this accident, and that it is best avoided by lateralizing the external incision in a sufficient manner. But the intestine may be divided while the surgeon is making his internal incision, or enlarging the one which he has already made, and certain circumstances may render it a matter of some difficulty to avoid this accident.

It must be remembered that the anterior wall of the rectum lies close on the posterior surface of the prostate, to which it is connected by cellular membrane, and that any abnormal development of the gut, or unnatural change in the position of parts, may bring the intestine immediately under the knife of the operator. Deschamps long ago remarked, that the rectum is sometimes so enlarged and dilated, in old persons especially, that it overlaps the prostate, which seems as it were, buried in it. Here the gut may be opened, while the surgeon is making his incision into the membranous

portion of the urethra, and such an accident would be likely to occur under any circumstances if the handle of the knife be raised too much during this step of the operation. To avoid it, some surgeons advise us to open the membranous portion of the urethra from behind forwards. From the limited extent to which the prostate is now divided in the second stage of the lateral operation, it seems difficult to understand how the rectum can be injured at that time. Our method of operating at least does not expose us to such an accident, but from the accounts of the French writers, it would appear that it is not a very unfrequent attendant on the use of the lithotome caché, which divides the neck of the bladder from within outwards.

From the manner in which the bladder of very young children ascends into the pelvis, it is necessary to employ some caution in making the internal incision so as to avoid the gut. Dupuytren recommends that it be directed in an imaginary line drawn from the umbilicus to the tuberosity of the ischium. In children and healthy persons this accident is seldom of much importance, unless the wound of the intestine happens to be extensive. Generally speaking, the opening into the gut closes with the cicatrization of the wound in the perinæum; but in adults, or when the wound is large, the result of the accident may be recto-vesical fistula of a permanent nature. This distressing infirmity must be treated in the appropriate manner; but it is obstinate, and often baffles our best directed efforts for its cure.

Lastly, the rectum has been torn or disorganized

during the attempts made to extract enormous calculi; but such an accident never occurs in modern surgery.

We next come to the secondary accidents of lithotomy, in which the causes of death may be included. I ought, perhaps, to have mentioned, that convulsions sometimes attack the patient during the operation, and recur after its completion. This is fortunately a rare accident, for it is one of a very dangerous kind.

The shock which the operation inflicts on the nervous system is an accident of an analogous kind, and all lithotomists are familiar with it, as one of a serious nature, not unfrequently terminating in death. The fact is, that previous to the revival of the lateral operation by Cheselden, lithotomy was a most formidable operation, and the sufferings inflicted by the Marian method were almost inconceivable. No wonder, then, that patients looked upon the operation with horror, or that long-protracted suffering should often have inflicted on the system a shock under which many rapidly sunk. This fear of the operation continued long after the introduction of the improved method—indeed I may say it continues to the present day—and the moral influence of such apprehension, joined to the suffering inevitable in difficult cases, are the chief cause of the sinking now alluded to.

One of the most popular arguments in favour of lithotrity was, that patients looked on it with less fear, suffered less during its performance, and hence, that the effects of a violent shock to the nervous system were less to be apprehended. This was true formerly, but the argument has lost much of its force since the disco-

very of chloroform. It is now the practice to produce insensibility before proceeding to operate, and the effect on the system is thus greatly mitigated, though I cannot say invariably avoided. The instinctive feelings of the nervous system occasionally resist even the power of chloroform. An example of this occurred not long since in the practice of Mr. Lawrence, at St. Bartholomew's Hospital. Although chloroform had been administered, the nervous and irritable state excited by the operation continued, and the patient sunk on the third day from the mere shock. No organic disease was found to explain the fatal result. It would be a highly interesting point to determine how far the results of lithotomy have been modified since the discovery of chloroform, but I fear that a long period must elapse before materials for such a determination can be collected together.

Several nervous states, which should be distinguished from each other, are comprehended under the general term "shock." In the first place, it may act on the *morale* of the patient, who dies suddenly, and under the hands of the operator, from mere fright. Examples of this kind are recorded, but such an untoward result is extremely rare. The very fear of the operation may kill the patient. The most remarkable case of this kind perhaps on record is related in the "Gazette Medécale," December 7, 1850. M. Dubousquet, a veterinary surgeon of Bourdeaux, sixty years of age, had suffered under symptoms of stone for twelve months. He wished to have lithotrity performed on him, but the neck of the bladder was too irritable, and he therefore agreed to submit to lithotomy. He did not appear to

be under the influence of any apprehension. He was placed on the table, and M. Cazenave was about to introduce the sound, when he became suddenly pale and fainted. He never rallied, and died in three-quarters of an hour. In the second place, the patient may sink under extreme exhaustion, from which he never rallies. This state is most likely to occur in debilitated subjects, or when any quantity of blood has been lost during the operation, but its most common exciting causes are, the sufferings of a long-protracted operation. I have already mentioned that long operations are always more or less dangerous, and I have shown how the prolongation usually depends on various difficulties connected with the extraction of the stone. These may be so great as to keep the patient an hour, or even more, on the table, while, in spite of every care, the injuries inflicted on the soft parts must be proportionate to the difficulties experienced. Under such circumstances the patient is often removed to bed in a state of deep prostration, from which he never rallies; the face is deadly pale, the skin cold and moist; the pulse irregular, fluttering, or indistinct; the breathing also irregular and disturbed; the eye-ball is uprolled; there is thirst, with great restlessness of body, and incoherence of mind. This is a most dangerous state, which may terminate fatally in a few minutes or a few hours. It demands care and unremitting attention. The patient must be carried at once to bed in the horizontal position; he should then be enveloped in a warm blanket, and bottles of hot water should be applied to the feet, while a free access of air to the face is provided for. As soon as he can swallow, small quantities of some stimu-

lus, as hot brandy-and-water, ammonia, &c., are to be given; in a word, the usual treatment of excessive exhaustion must be pursued, until some reaction sets in.

In other cases, where the extraction of the stone has been rapidly performed, with violent and sudden distention of the neck of the bladder and prostate, the nervous system experiences a shock in the true sense of the word, and the patient sinks rapidly, with symptoms nearly the same as those just described. Finally, the effect of the shock to the nervous system may be rather irritative than depressing. Though much less dangerous than severe prostration, or sinking, this is a very troublesome state. It bears much resemblance to the one met with after lithotrity. Sometimes the irritation manifests itself by a severe attack of delirium, unaccompanied by prostration. This is a dangerous form. In other cases, the patient is seized with shivering soon after the operation, becomes extremely restless, wanders at night, and if the state continues, falls into a condition very analogous to that denominated irritative fever; perfect rest, with the use of anodynes and gentle stimulants, are the best remedies in such cases.

As I propose reserving hæmorrhage, cystitis, infiltration of urine, purulent infection, and the chief causes of death after lithotomy, for a separate chapter, I shall pass them over here, and conclude with a notice of some minor accidents.

Retention and incontinence of urine occasionally follow the lateral operation. An impediment to the free discharge of urine through the wound may occur under two very different circumstances. Sometimes it

arises from sub-inflammatory engorgement of the wound along its whole course. At other times the impediment depends either on spasmodic action about the neck of the bladder, or more frequently on coagula produced by some slight vesical hæmorrhage.

The retention of urine from these latter causes is never complete ; but it gives rise to many disagreeable symptoms, and may become dangerous if neglected, from its influence in exciting renal disease. Spasmodic retention is easily relieved with the catheter ; to that form depending on coagula in the bladder, the instrument is not so well suited, because it soon gets plugged up. M. Civiale recommends us to inject tepid water into the bladder, and pass up a small flexible sound through the wound into the perinæum ; other surgeons advocate the use of cold over the region of the bladder. The retention may go on to complete suppression of urine. Here the kidneys have become implicated, and the accident is, I believe, beyond the resources of our art.

Incontinence of urine also occurs occasionally. It is a rare accident. I have never met with it myself, though in Deschamps' time, it seems to have been more frequent, for that celebrated lithotomist met with ten examples in his own practice and in that of others. Surgeons are not agreed on the precise cause of this disagreeable accident. It was much more frequent when the lithotome caché was in vogue, and hence may sometimes be connected with too free incisions of the neck of the bladder.

In other cases the incontinence may reasonably be attributed to loss of power, arising from over distention of the neck of the bladder during extraction of the stone.

In children, incontinence has occurred after very simple operations, and the symptoms may continue for many years in spite of treatment.

Impotence, from division or inflammation of the seminal ducts, is so rare an accident after the lateral operation, that I shall not notice it here. Besides, if it does occur, we have no remedy for it.

In speaking of the after treatment, I mentioned that, in the ordinary course of things, the wound through which the stone has been extracted gradually contracts, and is finally healed in about thirty or forty days. But it may happen that the healing of the wound does not proceed in so favourable a manner. Sometimes it makes no progress whatever, remaining pale and flabby ; yet no evident cause can be discovered. In other cases the wound goes on well for several days, after which it rapidly assumes an unhealthy aspect ; constitutional symptoms set in, and the patient dies. Here the condition of the wound depends on some internal disease which has been developed. Finally, whenever the soft parts have been much injured during the extraction of a rough, large stone, they may inflame as a necessary consequence of the violence used. In such cases the inflammatory action usually commences within twenty four hours after the operation, and may assume an erysipelatous character, or run into gangrene. This accident is often followed by fistula in the perinæum. When the wound has not healed kindly, or when any portion of it has been destroyed by gangrene, a fistulous communication with the bladder is, of course, most likely to ensue. The discharge of phosphatic gravel through the wound may also be the cause of fistula ; and in some cases the

urine is so highly charged with the phosphates, that it deposits them in its passage over the surface of the wound.

Some diversity of opinion exists as to the frequency of perinæal fistula after the lateral operation. From my own experience I should be disposed to say that it is a very rare accident ; but some foreign writers take a different view of the matter.

These fistulæ are extremely difficult to heal. A catheter must be kept constantly in the bladder, and an attempt made to heal the fistulous track with the aid of caustics. It has been observed that a second operation has cured the fistula left by the first one.

Relapse of the complaint is the last accident that remains. It has, however, been noticed in a former chapter. Phosphatic deposits are sometimes reproduced in great quantity after the operation ; when this occurs, we must leave the wound open, wash out the bladder frequently with tepid injections, and combat the inflammatory state of the bladder, on which the tendency to phosphatic secretion depends.

CHAPTER XIII.

CAUSES OF DEATH FROM LITHOTOMY.

I HAVE thought it might be useful to reserve the principal accidents of lithotomy, and describe them together under the head of "Causes of Death." These latter shall form the subject of the present chapter.

The most formidable accidents of the operation of lithotomy are hæmorrhage, infiltration of urine into the cellular tissue of the pelvis, suppuration and abscess of this tissue, inflammation of the bladder, peritonitis, purulent infection, and finally, secondary disease of the kidneys, or other parts excited by the irritation which the operation has produced. The "shock" is also an occasional cause of death; but since the discovery of chloroform this accident has lost so much of its gravity that it seldom gives rise to a fatal result, and I have therefore described it with the other less formidable accidents.

The hæmorrhage connected with lithotomy may be of two kinds, and occur at different periods. It may be arterial or venous; and it may occur either during the performance of the operation, or at an uncertain interval after it; being, in surgical language, primary

or secondary. Let us consider these four species of hæmorrhage, and commence with the most interesting one—bleeding from division of an artery during the operation.

The arteries of the perinæum are derived from the internal pudic. (*See* Fig. 84, page 170). This branch of the internal iliac having passed out of the pelvis through the greater sciatic notch, and having turned round the spine of the ischium, again enters through the lesser sciatic notch, descends along the inner surface of the tuber ischii, and ascends upwards and forwards in the direction of the ramus of the ischium to the level of the sub-pubic ligament. As the internal pudic winds round the tuber ischii, and as it ascends, it is closely bound down on the bone by the obturator fascia, rendered there more dense by the expansion of the great sciatic ligament. Near the origin of the erector penis muscle it becomes more superficial, taking an oblique direction upwards and inwards towards the bulb of the urethra. About an inch behind the transversus perinæi muscle it gives off two, three, or more hæmorrhoidal branches to the rectum, and about half an inch from this point furnishes the superficial artery of the perinæum.

The superficial artery of the perinæum is always large at its origin, and ascends obliquely towards the scrotum in the subcutaneous cellular tissue corresponding to the depression between the erector penis and accelerator urinæ muscles, where we may leave it, as it no longer concerns the lithotomist. In the early part of this course it is covered by the superficial fascia of the perinæum towards the surface, and by the transverse muscle on its pelvic aspect ; while crossing this muscle

it sometimes gives off to it a small branch, called the transverse artery.

The internal pudic continues under the obturator fascia, above the attachment to the pubes of the corpus cavernosum, and ascends pretty close to the ramus of the pubes. About three-quarters of an inch from the origin of the superficial artery of the perinæum, it sends off the artery of the bulb, which runs across just below the triangular ligament, and is entirely distributed to the bulb of the urethra. Having given off this branch, the artery continues to ascend a little more along the ramus, and divides into two branches, one to the corpus cavernosum, the other to the dorsum of the penis.

From this brief description it will be seen that the parts concerned in the lateral operation are abundantly supplied with vessels, and we might conclude that hæmorrhage must be a frequent accident. It may have been so formerly, but my own experience would lead me to conclude that dangerous hæmorrhage is far from being of common occurrence after the lateral operation. Our best lithotomists are of the same opinion. Mr. Liston, if I remember aright, states that he had only one case of severe bleeding in one hundred operations.

The accident, on the other hand, appears to be much more frequent abroad. Boyer considers hæmorrhage as one of the most frequent accidents of lithotomy; and M. Begin, who took great pains to ascertain the proportion of fatal cases produced by hæmorrhage, sets it down as one in four—that is to say, one death out of every four deaths after the lateral operation, is occasioned by hæmorrhage. This leads to the inference

that there must be some very considerable difference between our method of operating and the one adopted in France. Perhaps it may consist in the use of the lithotome caché, from which the incisions are more extensive. When English surgeons employed the cutting gorget, hæmorrhage was much more frequent than it is at the present day.

The sources of primary hæmorrhage during the lateral operation may be various; for the main trunk of the internal pudic artery, or any of its branches already noticed, may be divided. Some arteries which the superficial perinæal sends across towards the median line, necessarily lie in the way of the knife, and cannot be avoided; but in the normal state of things these vessels do not bleed very profusely, and can be easily secured.

Hæmorrhage, properly so called, may arise from division of the superficial artery of the perinæum, the transverse artery, or the artery of the bulb, and the internal pudic itself. In some cases the accident arises from the surgeon's making his incisions in an irregular manner; but the most frequent cause, I believe, is some irregularity in the origin, course, or relations of the numerous bloodvessels distributed to the perinæum.

As I have already observed, the operator may, in making his incisions, err in three ways: he may commence his incision too high, he may commence it too low, or he may incline it too much laterally towards the tuberosity of the ischium. Each error may bring its peculiar consequences after it.

When the incision is commenced very high up, the point of the knife is apt to fall on the bulbous portion

of the urethra, or divide to one side of it the artery of the bulb. The late Mr. Key used to affirm, that the artery of the bulb was generally divided in the lateral operation; but this was undoubtedly an erroneous impression. It takes its origin too high up from the pudic to run any danger, unless some variety in its origin exist. From its deep position, and the readiness with which it retracts within its sheath, the surgeon may experience much difficulty in taking it up.

By prolonging the incision too far downwards, that is to say, carrying it much beyond the level of the tuber ischii, the superficial branches which the internal pudic sends to the margin of the anus are almost sure to be divided; but here again the superficial situation of the vessels, which are not usually large, enables the operator to secure them without difficulty.

The trunk of the pudic artery itself may be divided when the incision is lateralized too much, and its lower angle made to terminate very close to the ramus of the ischium. This accident has happened in the hands of the very best surgeons; yet I cannot help thinking with M. Blandin, and many other anatomists, that it is impossible for it to occur, unless there be some irregularity which disturbs the normal relation of parts at the floor of the pelvis. The trunk of the internal pudic artery is closely bound down to the ramus of the ischium by a layer of dense fascia, and is nearly an inch and a half from the margin of the anus; nor does it begin to detach itself from the bone until near its terminal division. Under ordinary circumstances, then, I am of opinion that the trunk of the internal pudic cannot be wounded during the lateral operation.

The accident, however, has occurred, and to the masters of our art. Deschamps relates how Desault cut the internal pudic with Hawkins's gorget. The same misadventure has happened to M. Roux, to Dr. Physick, in America, to Sir Charles Bell, Sir E. Home, and others, in this country, and twice to Klein, in Germany. Finally, the superficial artery of the perinæum may be implicated, because, in some subjects, it is near to the median line; but the artery can be taken up without difficulty in this situation.

Having thus pointed out the various sources of primary hæmorrhage which depend on errors in the mode of making our incisions, we have to consider the more frequent ones connected with the abnormal origin or course of the arteries of the perinæum. This cause of primary hæmorrhage was alluded to in a general manner by Deschamps; but it is only since the works of Barclay and Harrison, Meckel, Tiedeman, and Quain, appeared, that we have been able to follow it up in a clear and satisfactory manner. The trunk of the internal pudic artery, as I have said, is closely bound down by fascia against the ascending ramus of the ischium, and thus lies more than half an inch out of the way of the knife in the lateral operation. In some cases, the trunk of the vessel is not so closely applied on the bone, but begins to ascend towards the median line almost as soon as it leaves the level of the tuberosity. Here the danger of dividing it is great in proportion to the lateral direction of the incision on the one hand, and the median inclination of the artery on the other.

Mr. Coote, of Bartholomew's Hospital, has recorded a

very remarkable example of this deviation ; as soon as the internal pudic had re-entered the pelvis, it passed over to the rectum, and ascended along it towards the triangular ligament, where it divided into its three terminal branches, one to the bulb, the other to the corpus cavernosum, and the third to the dorsum of the penis. Mr. Coote remarks, that the pudic artery would have been unavoidably divided in this case had lithotomy been performed.

The inferior hæmorrhoidal artery is usually detached from the trunk of the internal pudic about the level of the posterior margin of the anus, but it often arises much higher up, sometimes close to the edge of the transverse muscle, and there crosses the perinæum obliquely downwards and inwards. In such case its division must be inevitable, and the surgeon should be prepared for the accident, lest the unexpected occurrence of hæmorrhage at an early stage disconcert him.

The transverse artery of the perinæum is occasionally double, and if the two branches were divided, the bleeding would of course be more copious than if a single vessel only existed.

The artery of the bulb is subject to numerous varieties of much importance in connexion with lithotomy. This artery sometimes arises much lower down than usual, and crosses the perinæum obliquely upwards in the way of the lateral incision. A good specimen of this variety is preserved in the Museum of St. Bartholomew's Hospital.

In some cases, the artery is either very small, or altogether absent ; in others, it arises from the obturator artery.

The course of the vessel is also liable to variety, for it has been found passing backwards towards the rectum, or running immediately above the lower margin of the triangular ligament to join the bulb. Sometimes the artery of the bulb of one side furnishes that of the opposite, and then it is very large; in such a case, if the single trunk happened to be on the left side, its division would inevitably be attended with great hæmorrhage.

The pudic artery is said to be sometimes wanting, and its place supplied by a vessel which Mr. Quain has denominated the accessory pudic; it would be more correct to say that in some cases the internal pudic never leaves the cavity of the pelvis, but descends along the postero-inferior surface of the bladder to the prostate, which it either penetrates or winds round, to be distributed to the penis.

Here the artery is very much exposed during division of the prostate; and hæmorrhage may also be the consequence of varieties in the course of the dorsal artery of the penis. These latter are much more frequent than is commonly supposed. Indeed, the dorsal artery so often arises from the obturator or some other branch of the hypogastric, and passes forwards under the symphysis pubis to the dorsum penis, that the older anatomists, and even Winslow, mistook this for the regular distribution. In many other cases, however, the dorsal artery, instead of coming out with the vein under the symphysis pubis, gains the side of the prostate, round which it winds to the dorsum penis. The late Mr. Shaw, of the Middlesex Hospital, lost a patient from division of this anomalous branch while incising the prostate; and Pro-

fessor Harrison, of Dublin, justly remarks that the anomaly may account for many other cases of fatal bleeding during this stage of the operation.

We are totally unacquainted with the causes which produce these curious varieties in the arterial system, but I may remark that the dorsal artery of the penis, when anomalous in origin, has a strange tendency to attach itself to the obturator artery. Dr. Hume has recorded a case where the obturator arose from the epigastric, and gave off the dorsal artery in such a way, that whether the patient had been operated on for hernia or for stone, he must have been exposed to hæmorrhage. In one other remarkable case, where the obturator arose from the femoral just below Poupart's ligament, it furnished the dorsal artery of the penis. The preparation is, I believe, in the Museum of the University of Cambridge.

In a few rare cases, the dorsal artery of the penis has been found taking its origin as a distinct vessel from the external iliac, or from some branch of the hypogastric artery. The vessel may in such cases cross the surface of the prostate to gain the crus penis, and thus be exposed to injury.

What has been now said, explains how primary hæmorrhage may occur during the external or internal incisions. In the latter case, the danger is proportionate to the extent of the incision through the prostate: in the former case, to the amount of its deviation from the median line.

Venous hæmorrhage is another accident of lithotomy which occasionally occurs, although its possibility is denied by several authors. It is sometimes supposed to

arise from division of some portion of the bulb, an accident not easily avoided when we have to operate on old patients. The bleeding from this source, however, is easily commanded and seldom profuse. A more serious form occurs from division of the venous plexus about the neck of the bladder and prostate. In aged patients, and after long-continued irritation of the urinary organs these veins are apt to become abnormally developed, even to a varicose state. Besides this, they are enveloped in prolongations of the deep pelvic fascia, and thus prevented from retracting or becoming quickly closed after division. From these causes, troublesome venous hæmorrhage may come on in old patients submitted to the operation. Sir B. Brodie lost a patient within a few hours from this cause, having been foiled in all his efforts to restrain the bleeding. It may take place in adults, or even in children, under peculiar circumstances. M. Robert witnessed two examples at the Hôtel Dïeu of Paris. In one case, that of a young man, the venous plexus continued to pour forth blood until death ensued. No artery had been wounded. The second case was that of a child addicted to masturbation. The enlarged veins furnished a copious bleeding, which became suddenly fatal after an act of that vice. These are altogether exceptional cases, for we may lay it down as a rule that the danger of venous hæmorrhage is in direct proportion to the age of the patient.

The period at which secondary hæmorrhage sets in is very uncertain. It may be in some sort a continuation of the primary hæmorrhage, that is to say, some of the divided vessels may continue to pour out blood in small quantities. In other cases, it arises from some of the

smaller arteries, which did not bleed when first divided. Hence, we should make it an invariable rule to examine the patient's linen every day for any traces of blood, more especially if the pulse become feeble and the face pale. Secondary hæmorrhage, however, usually commences about the fifth or sixth day—sometimes earlier, on the third or fourth—sometimes later, on the eighth or tenth day. The discharge of blood is often moderate, yet it continues, and is very difficult to arrest, not unfrequently leading the patient to the brink of the grave. Various causes have been assigned for this secondary accident. Some attribute it to the separation of a slough; but this is rather an imaginary cause than one established by experience. Other writers speak of constitutional debility and improper movements of the patient as the exciting causes; but the most rational one is that pointed out by Cruveilhier, who attributes the secondary bleeding in most cases to the effect of inflammation on the mouths of the divided vessels. Under the influence of this inflammation, the walls of the vessels become relaxed, the clot is detached, and secondary bleeding is very likely to ensue.

I may take this opportunity of mentioning that in some rare cases the hæmorrhage is internal; in other words, there is no loss of blood through the external wound. Professor Cruveilhier relates a remarkable case of this kind, which occurred to Dupuytren. As the assistant who was left in charge of the patient saw no appearance of bleeding from the wound, he took little notice of the manner in which the man was sinking; the patient died of internal hæmorrhage within three hours.

Finally, secondary hæmorrhage may ensue from some

injury inflicted on the bladder itself during the operation. I have already alluded to this when speaking of retention of urine. This form most commonly follows extraction of the stone from an encysted bladder, or when the mucous membrane of that organ has projected into the interstices of a rough calculus, or when some of those fungoid growths mentioned in a former chapter exist. The hæmorrhage in such cases does not usually set in until some hours after the operation, and the torn vessels of the bladder are evidently its source.

The next fatal accident of lithotomy to which I would direct attention, is infiltration of urine into the cellular tissue of the pelvis, with its consequences. This is one of the most frequent causes of death after lithotomy. To understand completely the manner in which this accident may take place, it is necessary to have a clear notion of the arrangement of the different pelvic fasciæ ; but as I cannot devote any time to anatomical descriptions, I must content myself with one or two remarks of a general nature.

For surgical purposes we may consider the fasciæ of the pelvis as constituting a single aponeurosis, which takes its origin from the rim of the pelvis. From this circumference it descends, lining the bones and obturator muscle, until it arrives at the superior border of the levator ani muscle, where it divides into three layers. The internal layer lines the *internal* or superior surface of the levator ani muscle, forms the capsule of the prostate, and is continued between the bladder and rectum.

The middle layer lines the *external* surface of the levator ani, and becomes continuous with, or rather forms in front what is called the triangular ligament, behind

the internal limit of the ischio-rectal fossa. This it does by blending with the superficial fascia, in which it is lost round the anus.

The external layer of the pelvic fascia continues to line the obturator muscle, and is attached around the obturator foramen ; at many points this fascia lies close to the external surface of the peritonæum, from which it is merely separated by cellular tissue, and at all points it may be said that there is almost a continuous relation between the serous and fibrous membranes, by means of the same cellular substance.

It is this circumstance which renders infiltration of urine after lithotomy of so much importance, to say nothing of the evil effects arising from the fluid becoming imprisoned between the complicated layers of the aponeurosis.

Infiltration of urine may take place under two different circumstances. It may occur whenever the internal incision is carried beyond the limits of the prostate, or when the neck of the bladder and prostate are injured and lacerated during the efforts made to extract a large calculus. In both these cases, the fibrous capsule of the prostate is divided or lacerated ; the urine becomes infiltrated into the subjacent cellular tissue, inflammation sets in, and, according to its seat or extent, excites peritonitis or gives rise to sloughing and gangrene of the soft parts within the pelvis.

Infiltration, again, may occur, not from a too free internal incision, but because the external one has not been made on the same plane as the internal ; because it has been too small, or the soft parts which constitute its walls have been lacerated and rendered irregular

during the extraction of the stone ; anything, in a word, which impedes the free discharge of urine through the external wound, may become an occasional cause of this infiltration, which takes place in the perinæum, and not in the sub-peritonæal cellular tissue as in the former species. Simple inflammation of the pelvic cellular tissue, not caused by urinous infiltration, is, I believe, a very rare accident.

The distinction which I have just drawn between infiltration of urine into the cellular tissue near the neck of the bladder, and infiltration into the cellular tissue about the rectum, &c., may, in some measure, explain the difference of symptoms observed in different cases, and the greater rapidity with which some hasten to their fatal termination. We can readily understand, that when such an irritating fluid as the urine comes in contact with the cellular tissue close to, or immediately underneath the peritonæum, the latter membrane may be rapidly involved in the inflammation, and death speedily follow. On the other hand, the effects of infiltration into the more superficial parts of the wound are usually slower, but it gradually extends over a larger surface, causing sloughing, abscesses, gangrene, and the worst kinds of inflammation, which are almost as destructive as that involving the peritonæum.

The symptoms of urinary infiltration are extremely various, for the effects of the accident are modified by several circumstances. In some cases, the symptoms set in a few hours after the operation, and terminate fatally in a few hours more, or within a day or two ; in other cases, the progress of the disease is slower, and the patient does not sink until after a considerable period.

The sub-peritonæal form, is, as might naturally be expected, the most rapid and dangerous. The patient complains of pain about the neck of the bladder, and from the very outset has a peculiarly unfavourable and anxious expression of countenance; the pulse is small, weak, and rapid; the tongue soon gets dry, and the lower part of the abdomen tumid and painful; often there is vomiting; prostration now rapidly ensues; there is low delirium, and the patient dies within forty-eight hours.

In other cases the typhoid symptoms and prostration are not so great; the fever at first is of a more irritative character, and is occasionally interrupted by rigors; still, as the urine continues to work its way between the layers of the fascia, and the inflammation ascends along the sides of the rectum, more unfavourable symptoms do not fail to present themselves: the skin becomes hot, the tongue very brown, the intellectual faculties become confused, diarrhœa and vomiting supervene, and the patient either sinks in a state of prostration, or is cut off by the addition of peritonitis to his other maladies.

Nearly allied, in its cause at least, to the accident just mentioned, is purulent infection. This fatal complication does not often occur in the practice of English surgeons; indeed, I may say that it is extremely rare amongst us, and it is hardly ever seen unless phlebitis happen to be prevalent in the hospital at the time of the operation. In France, on the other hand, the accident would appear to be a very frequent one. I can only explain this difference by the circumstance, that the French lithotomists are accustomed to divide the pro-

state more freely than we do, and hence are more likely to wound the venous plexus about the prostate and neck of the bladder. However this may be, all French writers insist on the occurrence of purulent infection after lithotomy, and M. Blandin has shown that the accident may occur (even when the prostate has not been completely divided) from inflammation of the veins of the bulb of the urethra.

Inflammation of the bladder is a secondary accident common to both lithotrity and lithotomy, but I cannot agree with Boyer in thinking that it is of such frequent occurrence after lithotomy as to account for three-fourths of the deaths produced by that operation. It is necessary, in making any estimate of this kind, to distinguish the inflammation caused by the calculus from the inflammation produced by the operation, and not to attribute to the latter, effects which mainly depend on the former. The mere circumstance of a wound having been made through the prostate, is not, I believe, sufficient to develop any severe inflammation of the bladder in ordinary cases ; but the same cannot be said of long, or violent efforts to seize and extract large calculi.

Here, if any chronic inflammation has previously existed, it may readily be rendered acute by the manipulations employed ; but I must repeat that, under ordinary circumstances, we have little to apprehend from severe cystitis. It is not likely to occur unless the bladder has been previously diseased, or certain obstacles, which I have already described, render the extraction of the stone long and difficult. Still, as many patients whom the lithotritist rejects fall back on lithotomy, and are operated on, it may happen that death

from cystitis is more frequent after lithotomy than after lithotrity.

It is a pity that surgeons who have examined hospital registers have left us no account of the causes of death in a given number of cases; so that each is now forced, according to his individual experience, to say hæmorrhage is frequent or rare, infiltration of urine is the most frequent cause of death, &c. Dupuytren, indeed, has attempted to supply this deficiency, but his table applies to so limited a number of cases, that it is of little or no value. In eighty-five cases operated on, in the Parisian hospitals, nineteen deaths occurred from the following causes:—

In seven, from inflammation of the bladder and cellular tissue.

In two, from hæmorrhage.

In one, from laceration of the prostate.

In one, from the calculus being encysted.

In one, from calculus of the prostate.

In one, from shock of the operation.

In four, from obstacles, consisting, in two cases, of the size of the calculus; in one, narrowness of perinæum; and in the other, excessive depth of perinæum.

In one, from cancer of the bladder.

In one, from gastro-entritis.

I should remark, besides, that this table applies to the bilateral operation.

There is, finally, another cause of death after lithotomy, and a frequent one likewise; but, in fairness, we should rather say that, in the cases to which I now allude, the operation has only hastened death, not been its actual cause.

I have already explained how vesical calculus seldom exists for any considerable time without affecting the general health, and either producing latent disease of the kidneys, ureters, &c., or at least producing a tendency towards disease in these organs, which the slightest exciting cause may light up.

I have also said that the lithotritist is very careful not to meddle with these cases, whenever he is fortunate enough to discover their nature, knowing full well the great chance which exists that they will terminate unfavourably. The lithotomist is perfectly aware of the same fact; yet, whether it be that he is more bold in his practice, or from other causes, it is certain that many patients labouring under incipient disease of the kidneys, or with suspicious symptoms, are submitted to the knife, whereas the lithotritist would decline interfering with them. In the majority of these cases, the operation hastens death by giving a spur to the organic disease already existing, or by lighting up an affection to which a strong tendency already exists. The patient would probably fall a victim to the disease sooner or later, but there can be no question about the fact that lithotomy, especially if there be the least obstacle to the extraction of the calculus, often hastens the fatal result in a remarkable manner.

We may, however, have a case in which the symptoms of renal disease are obscure, while the patient earnestly entreats to be relieved from his more pressing and palpable malady. Here it may be asked, supposing an operation to be decided on, whether we should select lithotomy or lithotrity. This comes to the same as if we asked which of the two operations is the more likely to de-

velope the renal disease already existing. I confess that my mind is not quite made up on this difficult point. Some authorities boldly assert, that lithotrity is less dangerous than lithotomy, whenever disease of the kidneys exists. I cannot go so far as this; our safest course, perhaps, will be to consider, in the most careful manner, all the circumstances of the case, and then, according to these, select the operation which seems less likely to irritate the bladder.

CHAPTER XIV.

LITHOTOMY AND LITHOTRITY IN THE FEMALE.

THE operations performed for the removal of calculi from the female bladder, require a separate notice, and I shall therefore devote a chapter to them.

Women are not very subject to stone in the bladder, at least not so much so as men. Every one is acquainted with this fact, but I believe that vesical calculus exists in the female oftener than is generally supposed. We possess few documents which throw any light on this point. The following are the principal that have fallen under my observation, and they are very imperfect, for they only show the relative proportions of males and females in a given number of persons operated on, instead of showing the proportion of females in a given number of calculous patients; however, they furnish something less vague than the unsatisfactory expressions, rare and frequent.

In Mr. South's translation of "Chelius's Surgery," I find a list of all the operations of lithotomy performed in St. Thomas's Hospital from 1822 to 1845, that is, during a period of twenty-three years; 144 males were

operated on and only two females. A surgeon, we see, may remain attached to one of our large hospitals all his life without being called upon to operate on the female. Mr. South's table gives a proportion of one female for seventy-one males; this is greatly below the average. In Mr. Crosse's tables formed from the cases in the Norwich Hospital, we find that out of 704 patients operated on, 669 were males and thirty-five females, giving a proportion of one female to nineteen males.

This agrees pretty closely with the proportions observed at the Hôtel Dieu of Paris. From 1808 to 1830, 284 calculous patients were admitted into that hospital, of whom seventeen were females, which gives a proportion of one female to sixteen males. From the tables collected by M. Civiale, I find that of 1104 operated on in the Lombardo-Venetian States, 1047 were males, fifty-seven females, or one in eighteen; and of 2834 in France, 2711 were males, 123 females, or one in twenty-two.

All these tables agree very closely, and show that for about twenty males operated on for stone, there will be one female. It is, however, very probable that the proportion of calculous affections in the female is still higher, because we all know that delicacy prevents numbers of females labouring under urinary disorders from applying for hospital relief. The same holds good in private practice; of 307 patients operated on by M. Civiale, only seven were females. Dupuytren collected 356 cases of lithotomy which occurred in Paris during a period of ten years; 312 of the patients were males and forty-four were females, which gives a proportion of one female to eight males.

Before describing the various operations proposed or performed for the extraction of stone from the female bladder, I may mention a few anatomical circumstances connected with lithotomy in the female which should be kept in mind.

The relative anatomy of the parts concerned in lithotomy is totally different for the male and female, leading to modes of operating essentially distinct. In the male we extract the stone through the perinæum; in the female through the urethra. The female bladder is placed in front of the uterus and above the vagina, to which it is united by dense cellular substance. The neck of the bladder lies between the vagina and the symphysis pubis, about an inch below the angle of junction of the bones, and from this point the urethra runs forwards in nearly a straight line for about an inch and a half, to terminate in its external orifice, just below the clitoris. The female urethra is larger than that of the male, and is much more dilatable; the neck of the bladder is not surrounded by any prostate; there is no perinæum, in the male sense of the word, to be traversed, with its large bloodvessels and complicated fasciæ; the bones are widely expanded round the bladder; and, finally, in case of need, behind and beneath the organ exists a large natural canal, which as it gives passage to the head of a child, may also serve for the extraction of any moderately sized calculus.

In a former chapter I described the various improvements through which the operation of lithotomy in the male has passed, until it arrived at its present perfection. For the operation as applied to females I cannot say the same. We have made little or no progress in the

art of extracting stones from women ; the operation is now nearly what it was some 2,000 years ago, an unscientific and comparatively unsuccessful proceeding.

The methods employed for extracting calculi from the female bladder may be arranged under three heads :— those in which a cutting instrument alone is employed; those in which we have recourse to dilatation of the urethra ; and a mixed method, composed of incision and dilatation.

The first of these methods is the oldest, and the urethra and neck of the bladder have been divided in every possible direction.

Celsus recommended the operation to be performed in the following manner. For girls, the fingers were passed into the rectum, and for women into the vagina. The calculus was thus pressed forwards against the neck of the bladder, and a transverse incision was made directly on the foreign body either below and to the left of the meatus, for girls, or between the meatus and os pubis, for women. This method has long since been abandoned ; but Celsus was fully aware that small calculi might pass away per urethram without any operation, and speaks of a hook by which their extraction may be effected.

The objections to the Celsian method are self-evident; yet it was revived in 1823, with some modifications, by M. Lisfranc. The well known reputation of that celebrated surgeon, who held one of the highest ranks in Paris as an operator, must be my excuse for describing this operation ; it is a little less objectionable than the Celsian method, and serves to illustrate what I have just

said relative to the progress or rather non-progress of lithotomy for females. Lisfranc denominated his operation "the vestibular incision." A common male staff was introduced into the urethra, and intrusted to an assistant, who pressed the urethra and vagina downwards with it, grasping the handle firmly and keeping the convexity of the instrument upwards. The operator then placed the fore and middle fingers of his left hand on the points where he intended making the first incision, and having thus placed the cellular tissue on the stretch, he made, with the point of a straight bistoury, a semilunar incision through the integuments, commencing on the right side on a level with the urethra, ascending close to the symphysis pubis and terminating on the left side on the same level where he commenced. The operator continued to divide the cellular tissue, layer by layer, until he arrived at the body of the bladder above its neck. The left thumb was now introduced into the vagina and the left fore-finger into the wound, the wall of the bladder being rendered tense between them, after which the body of the bladder was divided either transversely or longitudinally with the bistoury or on the grooved staff. Lisfranc preferred the transverse incision.

The object of this method was to avoid the incontinence of urine which so often follows division of the neck of the bladder; but the objections to it are thus fairly stated by Chelius. The bladder is divided where there is least space for the extraction of the stone; it may give rise to division of the pudic artery; the vascular net-work round the neck of the bladder may pro-

duce troublesome hæmorrhage, and infiltration of urine may easily occur from the difficulty of keeping the internal and external incisions on the same plane.

The Marian method took the place of Celsus's operation, and like it, was nothing more than a clumsy attempt to apply as nearly as possible to females the method adopted for males. A grooved catheter was introduced into the urethra, and its convex surface made to project towards the point to be incised; an assistant drew aside one of the labia to expose this point, and the operator then cut down on the urethra, commencing his incision about a finger's breadth from the femur, between it and the meatus. Having cut into the urethra, the dilating instruments were introduced, and the operation terminated as for the male. The Marian method was hence made up of incision and dilatation, and all that has been ever done since was to subdivide this mixed method into two; some surgeons advocating incision alone, and some dilatation, while others adhered and still adhere to the ancient principle of combining both.

Franco appears to have followed the method of Celsus, and was an opponent of dilatation; yet that great surgeon was acquainted with the advantages of the modern operation, and says that when the stone is small, or not requiring too much dilatation of the urethra, it may be extracted without cutting. It is not easy to say when originated the method of dividing the urethra or neck of the bladder, without making a lateral external incision as Celsus and Marianus did. The first clear account of such an operation is to be found in the works of Ambrose Paré who saw the elder Collot

perform it. A grooved staff was introduced into the urethra and on it a small incision was made vertically upwards through the neck of the bladder. This done, the forceps was introduced and the incision dilated until sufficient space was obtained for the extraction of the stone.

Collot clearly explains that the advantage of his method consisted in the wound uniting more readily, since from its situation the urine was not so likely to flow through it. Dupuytren preferred the lithotome caché to the knife and staff, as being safer and more easy to manage.

As Lisfranc revived the Celsian method, so did M. Dubois revive and give his name to this vertical incision of Laurent Collot. He, however, modified it so far that he divided the whole length of the urethra as well as the neck of the bladder. Instead of the knife Richerand and Dupuytren employed the bistouri caché.

Sir B. Brodie also attempted to revive the original operation of Collot, and divided the membrane of the urethra under the symphysis pubis, directly upwards, after which he dilated with Weiss's instrument.

The same objection holds good against this operation as against all those in which the opening is made between the urethra and pubis : viz., that it necessitates the extraction of the calculus where the space is smallest. The advantages attributed to it are much insisted on by Dr. Gross, who says, that he prefers this incision to any other. It is less liable, he says, than any other to be followed by incontinence of urine, because the wound readily heals at an early period, and it is entirely free from the danger of hæmorrhage. As to

incontinence, Dr. Gross certainly takes a wrong view of the matter, for this disagreeable accident ensued after the first three operations performed by Sir B. Brodie according to this method.

This mode of simply dividing the urethra from within outwards having been thus introduced and made known through Ambrose Paré's works, operators set about modifying it; but their ingenuity did not seem to get beyond the very simple step of changing the direction of the incision. Some cut sideways, some obliquely down, some directly down, while some divided both sides of the urethra. This is pretty nearly the whole scale of variations which could be composed on the original air.

Dionis, I believe, was the first who proposed the double incision of the urethra with a narrow bistoury; he divided the orifice of the urethra horizontally on both sides, proportioning the extent of the incision according to his notion of the size of the stone; he then introduced a dilator and gradually expanded the urethra and neck of the bladder; but in spite of the care with which he operated Dionis informs us that three-fourths of the woman remained affected with incontinence of urine, and that this accident was inevitable whenever the calculus was large.

Mr. Liston and other surgeons have introduced modifications of Dionis's operation. The principles are the same; Mr. Liston notched the neck of the bladder only on both sides, towards each ramus of the pubis, and then continued the dilatation for a few minutes until the fingers could be admitted into the bladder.

Another modification proposed is somewhat similar. A straight staff having been introduced into the bladder, the groove being directed downwards and to the left side, a straight probe-pointed bistoury is passed along the groove until it has nearly reached the bladder; it is then drawn outwards, and the anterior half or two-thirds of the urethra divided, as the bistoury is withdrawn. If the stone be large, a slight notch may be made in the right side of the urethra, somewhat similar to the first incision, dilatation being effected with the fingers.

Each operator conceives that his method is the one calculated to diminish the chances of incontinence.

Louis divided the whole of the urethra horizontally on both sides with a double-edged instrument, while many other surgeons divided only one side of the canal (usually the left).

The vertical incision directly downwards has been principally recommended by Professor Chelius, of Heidelberg. It may be made with a common bistoury or the lithotome caché. A grooved staff is passed into the bladder, and its concavity made to press downwards. The cutting instrument is then carried along the groove into the bladder, dividing directly downwards, and in the mesial line the urethra, the corresponding wall of the vagina, and the neck of the bladder. Chelius affirms that the free cut does not increase the danger of incontinence of urine; while vesico-vaginal fistula is not more to be dreaded than after the common mode of dividing bladder and vagina.

Le Dran divided with a particular instrument the neck of the bladder obliquely downwards; and this

method is the one usually employed at the present time, except that the wall of the urethra is also divided in the same direction.

It has been called the "lateral operation," and nothing can be more simple or easy of execution. A straight staff is passed into the bladder; the operator then grasps the handle of the staff and directs its groove downwards and outwards towards the ramus of the ischium; a probe-pointed bistoury is now passed into the groove of the staff and the whole length of the the urethra divided; the neck of the bladder may also be divided by the same incision if it be supposed that the size of the calculus requires it. The oblique incision often intersects a small portion of the anterior wall of the vagina.

The facility of arriving at the body of the bladder through the vagina must have suggested at an early period the operation now denominated, vagino-vesical. Fabricius Hildanus was the first who recommended it, but he does not seem to have performed his operation on the living body. It was afterwards taken up by Mery, who also confined himself to mere description; but Gooch, in his "Practical Remarks," relates some cases where it was performed with success.

The patient is placed in the usual position; a straight staff is passed into the bladder, the groove is directed downwards, and the end of the staff made to press against the vagina; the index-finger of the left-hand and a wooden gorget are also passed into the vagina, and the end of the staff is made to rest fairly in the concavity of the gorget. Both instruments are now firmly held together by an assistant, and the ope-

rator directs along his left fore-finger the point of a straight bistoury until he arrives at the groove of the staff behind the neck of the bladder, when he carries his incision forwards to the extent judged proper. The very great probability that vagino-vesical fistula will result, is the main objection to this operation ; but in cases of large calculi it has the immense advantage of not endangering life.

Having thus described all, or nearly all, the methods of extracting stone from the female bladder by means of a cutting operation, let us consider those conducted on another principle, and in which dilatation is exclusively employed.

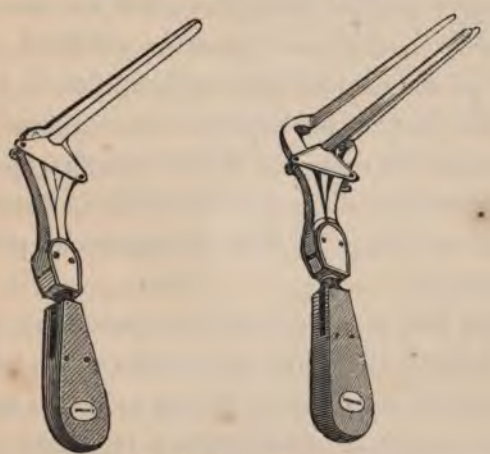
The spontaneous discharge of urinary calculi through the female urethra soon proved the great dilatability of that canal, for calculi of a very great size have come away through the natural passages without any interference of art. Several of the most remarkable examples are quoted in "Cooper's Surgical Dictionary."

At first surgeons confined dilatation to the removal of small calculi, and this is the modern practice. We have merely returned to the method of the ancients. Franco, as I have said, applied dilatation to cases of small calculi. His successors, however, soon went further. In the early part of the seventeenth century Jannot practised dilatation alone, and his pupil, Tolet, followed the same example. This method did not prevail long. Experience demonstrated at once the inconveniences arising from excessive dilatation of the neck of the bladder, and surgeons returned to the only sound practice, viz., that of confining this method to small, or at most moderately sized calculi. But even then their

opinions were divided on some points of importance; with what kind of instruments should the dilatation be effected? and again, should it be effected in a slow or in a rapid manner? Some authors recommend the dilatation to be effected with solid or flexible bougies, and I perceive that Dr. Gross, in his recent work, says, he prefers gum elastic catheters.

Dr. Douglas first proposed using pieces of prepared sponge, and this method continued in vogue for a considerable time.

Fig. 95. *Fig.* 96.



WEISS'S FEMALE DILATORS.

Fig. 95.—Instrument closed. *Fig.* 96.—Instrument open.

Other operators dilated with a blunt gorget, and Sir Astley Cooper, who was a great advocate of dilatation, used to employ an instrument constructed on the principle of the speculum oris or speculum ani. In this country we now usually employ the dilator made by Mr. Weiss.

The kind of instrument, however, is of much less

importance than the kind of dilatation. In what manner should this be effected? should it be rapid, in order to avoid the tediousness and pain which sometimes, during this process, are intolerable? or should it be slow and gradual to avoid the risk of entailing on the patient incontinence of urine? These are points on which professional men are not yet fully agreed. The morbid contractility of a diseased urethra is, undoubtedly, less affected by slow than by rapid dilatation. If we enlarge the diameter of a stricture rapidly, the disease is more apt to return than if we employ gradual dilatation; but we cannot logically infer from this that the same will hold good for the neck of the bladder and urethra when in a natural state. The degree of dilatation besides must depend on the presumed diameter of the calculus, and I have already shown how difficult it is to arrive at any precise knowledge on this point with the means at present at our command.

Perhaps the safest practice to pursue in case the surgeon adopts dilatation, is that recommended by Sir Astley Cooper, who says, "If the stone be small the dilatation should be accomplished in a few minutes; but if it be large it will be better to dilate only a little from day to day, until the greatest degree of extension is accomplished." Dupuytren remarks, "That rapid dilatation is not much more painful than the slower, but that it is much more likely to be followed by incontinence of urine." It cannot, however, be denied that this is a tedious and disagreeable method, and hence many surgeons, even where the calculus has been large, have not hesitated to dilate the urethra in what

may be called a rapid manner. Thus Mr. Howard relates a case* in which he extracted a stone weighing more than two ounces from a female 23 years of age. The urethra was dilated with Weiss's instrument for two hours only, after which the foreign body, which measured two and a quarter by one and a half inches in its several diameters, was extracted without any difficulty. The cure, it is true, was only an imperfect one, for the woman was unable to retain more than half-a-pint of urine at a time, and this is the great objection to nearly all the methods adopted for the extraction of calculi from the female bladder. A considerable proportion of those operated on labour ever afterwards under the distressing accident of incontinence of urine.

This, in fact, is the stumbling-block, and although the statistical researches which I have made lead me to conclude that it is far from being so frequent an accident as some of our best operators infer from a limited number of cases, yet it happens often enough to have great influence in our choice of the method to be employed. It is difficult to say on which side the weight of surgical evidence preponderates. Many surgeons contend that dilatation is less likely to be followed by incontinence of urine than division of the parts, while many other excellent surgeons hold the directly opposite opinion. My own impression is, that division is less likely to entail this infirmity than excessive dilatation; but, on the other hand, lithotomy in the female is by no means the harmless operation that we are generally told that it is. When I come to the statistics of lithotomy in the

* Lancet, September 21st, 1850.

male, I shall show you that at St. Thomas's Hospital, from the year 1824 to the year 1846, the mortality was 1 in $9\frac{1}{2}$; the late Mr. Liston, who was a very successful operator, lost 1 patient in $7\frac{1}{4}$, while the mortality of Cheselden's cases was not more than 1 in $10\frac{1}{2}$.

These are highly favourable results it is true, yet they show what may be done by skilful hands. Now the mortality of lithotomy in the female does not vary materially from that shown by Cheselden's tables for the male. Let us take the best of our English tables, that of the late Mr. Crosse, of Norwich. Of 704 patients operated on, 35 were females, and of these 2 died, giving a mortality of 1 in $17\frac{1}{2}$. This is nearly the same proportion as the one furnished by a French table, the elements of which were collected by M. Civiale. Here out of 93 operations we find 7 fatal, giving a mortality of 1 in $13\frac{2}{7}$. In another table, given by the same author, and comprising 173 cases, we find 19 deaths, or about 1 in 9. In the 44 operations mentioned in Dupuytren's tables, to which I have already alluded, no less than 5 deaths occurred, giving a mortality of 1 in 9. The reports from the Luneville Hospital, however, show a much more favourable result. Out of 2,834 calculous patients admitted into that establishment, 123 were females, of whom 93 were operated on. Only 4 cases proved fatal, which gives a mortality of 1 in 23. Nor can it be said, that the mortality in any of these returns arose from the circumstance of the knife having been used; for the method adopted, in the majority of cases, was extraction by dilating only. Lithotomy in the female, then, is not the harmless operation which many writers assert

it to be, since if 10 per cent. of males die; 5 per cent. of females, if not more, fall victims to the operation.

With such a fact before us, it may be fairly asked, can nothing be done to render extraction of calculi from the female bladder less dangerous? I venture to think it may. In my judgment the lateral operation, as it has been called, should be abandoned altogether, and I have some doubts whether it would not be expedient to lay aside likewise the more modern process of nicking the neck of the bladder, or splitting up the urethra.

For small calculi I would employ dilatation only, and very large calculi I would either extract by dilatation and incision, or by breaking up the calculus into small fragments, and then extracting each separately; all intermediate cases (with a few exceptions) I would submit to lithotrity. With some account of this, I shall close the present chapter.

It is curious to observe the phases through which lithotrity has passed in its application to females. When this method of operating was first introduced, the enemies of lithotrity pretended that it was only applicable to the female. In one of the early editions of M. Velpeau's "Operative Surgery," we find the following passage: "Lithotrity is performed on the female infinitely more easily than on the male, and it is almost free from danger; the female urethra being wide, short, and dilatable, without any curvature, without prostate gland, or seminal orifices, is admirably fitted to give passage to the instruments, and it is not necessary to reduce the calculus into such small fragments." Yet after having delivered such a favourable opinion as this,

M. Velpeau subsequently declared, and still insists, that lithotrity is not applicable to female patients. He would exclude women as well as children from the benefit of the operation. In England there seems to exist some prejudice also against the application of lithotrity for the cure of calculus in the female; but on considering the arguments adduced, the only one of any force which I can discover is that drawn from the supposition that the female bladder is incapable of retaining the fluid injected into it previous to the operation.

The conditions of simplicity which distinguish the female urinary apparatus from the male, render the introduction of instruments so easy that it is unnecessary to enter into any examination of the obstacles which may present themselves during this part of the operation. Still it may be well to remark that the orifice of the meatus urinarius is narrow in some females, so much so, that the operator may experience some difficulty in getting the point of the lithotrite into it; and this is the more likely to happen because he his unable to fix the parts between his fingers as he can do in the male. This obstacle, however, is of little importance. The orifice of the meatus can be easily dilated by means of bougies; nor can any great inconvenience arise from nicking it with the bistoury if judged necessary. In some cases the urethra is, more or less, contracted along its whole length, and in a very irritable condition from sympathy with the disordered bladder. Although such a condition occurs much less frequently than in the male, and never reaches such a degree of intensity as when depending on disease of

the prostate and involving the neck of the bladder in males, it still requires attention, and should be combated by the ordinary means which I have already described.

The female bladder is, I believe, less liable to become seriously diseased than the male, from the effects of calculous irritation; and the obstacles arising from enlargement or disease of the prostate, are of course, entirely absent in the female. However the depression just behind the neck of the bladder, caused in the male by tumefaction of the middle lobe of the prostate, sometimes exists in the female also, though from a different cause. The lateral walls of the female bladder are naturally depressed, and in an aged patient this may be carried so far as to form a kind of sac at the floor of the bladder, in which the calculus or its fragments, are apt to lodge. In addition to this M. Civiale observes, that the uterus sometimes presses against the posterior and inferior walls of the organ, dividing its floor into two pouches, in which the fragments may likewise become engaged. It is well to bear these circumstances in mind, although any obstacle which they can create is far from having the same importance as those produced by enlargements of the prostate in the male. The canal of the urethra is so short and straight in the female that every portion of the bladder can be explored without any great difficulty, and the conditions of each case ascertained with a degree of precision which renders the task of the operator comparatively light.

The operative proceeding is the same for the female as for the male, and the indications relative to disease

of the urinary organs are also the same for both sexes. I need not, therefore, repeat what has been already said on this latter point; but I may remark that lithotrity has been successfully applied to cases of stone in the female bladder under circumstances which would certainly have contra-indicated the operation in the male. There are two principal reasons for this; in the first place, the operation can be terminated, *cæteris paribus*, much more rapidly in the female than in the male; it is easier to seize the calculus; it is easier to crush the calculus into fragments. All these advantages render it much less likely that the operation will be followed by irritation of the urinary organs, or by any dangerous accidents.

In the second place the fragments of the calculus are much less liable to be retained in the bladder or to become impacted in the urethra; and I have already shown that many of the evil consequences of an opeation in the male depend on the irritation excited by these two accidents.

In the female they are rare. There is no enlarged prostate to impede the free evacuation of the detritus; no curved canal to arrest their discharge, while the great dilatability of the urethra in the female renders it less necessary to break up the calculus into very small fragments, and thus contributes to render the operation less protracted in difficult cases.

The main objection brought forward in this country against the expediency of applying lithotrity to the female is derived from the alleged difficulty of making the female bladder retain the fluid injected into it.

It would certainly appear from many cases on record

that some operators have found it impossible to make the female bladder retain the fluid which they injected; and hence adopting the false method of reasoning from particulars to universals — they reject lithotrity altogether for the female. It may happen that the bladder of a female patient is small, contracted, excessively irritable, and incapable of retaining the injection. This occurs in the female as well as in the male, though I believe less frequently, and when it does occur lithotrity should not be undertaken. But this is no reason for converting the exception into a rule. Under ordinary circumstances the female bladder will retain the injection well enough, and if the bladder show any disposition to reject it, this can be overcome by elevating the pelvis a little more than usual, and by confining the quantity of fluid thrown in to four or five ounces. The rapidity with which the operation may be completed in the female renders it much less necessary to have the bladder distended with fluid.

CHAPTER XV.

PARALLEL BETWEEN THE DIFFERENT METHODS OF LITHOTOMY.

ALTHOUGH the lateral operation for the extraction of stone from the bladder is that to which surgeons have recourse in the great majority of cases, yet it is not altogether free from imperfection. This method necessarily exposes the patient to certain accidents, the influence of which may be illustrated by the general fact, that from one-fifth to one-seventh of the cases terminate fatally. Such is the result of the lateral operation when practised even by the most skilful surgeons in this and other countries; and although I do not mean to affirm that the fatal event should always be attributed to the operation—because it is sometimes had recourse to under such unfavourable circumstances that success is scarcely to be expected—yet the mortality is so considerable that many eminent practitioners have been induced to turn their attention to other methods, whereby the risk of the operation might, as they hoped, be more or less diminished. Besides this, certain cases occasionally present themselves to which the lateral operation is confessedly in-

applicable. If the surgeon persist in an attempt at applying Cheselden's method to these cases, the safety of the patient is compromised in the most serious manner; death, in fact, is sure to be the result; and hence we are led to inquire, how in these cases, which I shall presently describe, the bladder may be opened in a different manner, and the stone extracted by some method less likely to be followed by dangerous accidents, than the lateral operation.

In the historical sketch I described the different methods for the extraction of vesical calculi which have been employed at various periods, from the days of Celsus to the present time. Omitting what may be called modifications, we find no less than six different methods, but as it would be impossible to compare each one of these six with the remaining five, I shall adopt the more simple plan of briefly noticing the advantages and disadvantages connected with each method.

They may be taken up in chronological order.

The Celsian method consists in pressing the stone against the neck of the bladder with the fingers introduced into the rectum, and then cutting directly down upon the foreign body. This was the primitive operation, the one adopted in the infancy of surgery. The objections which might be advanced against it are so manifest that they hardly require any notice. The method necessarily excluded a numerous class of patients; it is not easy to introduce the middle and fore-fingers into the rectum of a young child; and it is inapplicable to aged persons, and nearly so to adults, from the great difficulty of hooking the fingers round the prostate in such a manner as to render it

possible to dislodge the stone and press it forwards against the neck of the bladder; indeed Celsus himself confined the method to patients between the ages of 9 and 14 years. From the way in which the incisions were made directly down on a foreign body supposed to be lodged in the neck of the bladder, but the real position of which the operator could never tell with any certainty, the surgeon could not know what parts he was dividing in the different steps of the operation. He had no grooved-staff in the urethra to guide him, and it is certain that the operation must have varied considerably at different times, being now performed one way, now another. Sometimes the incision fell on the prostate, sometimes on the neck of the bladder; in other cases, especially if the stone were large, the knife must have been carried into the space between the bladder and rectum, and the body of the bladder opened far behind the posterior edge of the prostate. These were necessary consequences of cutting down directly on the foreign body wherever it might happen to be. From the direction of the internal incision it was almost impossible to avoid injuring the vesiculæ seminales or vasa efferentia.

It is also evident that the internal incision could have borne no definite proportion to the external; the incision went on diminishing from the perinæum to the neck of the bladder, hence it was too large externally and too small internally; hence also the important parts about the neck of the bladder must have been contused and lacerated during the extraction of any calculus of moderate size, producing those unfavourable results which, in all probability, were the

reason why Hippocrates rejected lithotomy altogether.

I can only conceive one set of cases in which the Celsian operation might be admissible. The calculus is some times impacted in the neck of the bladder, with or without prolongations into the prostatic portion of the urethra. A grooved-staff cannot be passed beyond the foreign body into the bladder. These are cases very distressing to the patient, and very embarrassing to the surgeon ; retention of urine is imminent. Here the surgeon may be compelled to cut down directly on the foreign body, divide the prostate or neck of the bladder from without inwards, and extract the calculus in the best manner he can. But I shall not dwell on this at present, as the operation has been described under the head of "Urethral Lithotomy."

The Marian method, or the "apparatus major," as it has been called, consisted in making an incision into the spongy or membranous portion of the urethra on a grooved-staff, in introducing certain instruments through the incision into the bladder, and then forcibly dilatating the parts until a sufficient opening was obtained for the extraction of the stone. As originally practised this was a barbarous and cruel operation. The only advantages which it presented were those derived from the employment of a grooved-staff, and the avoidance of hæmorrhage ; but by how many inconveniences were these advantages counterbalanced ? To the Celsian method it was so far preferable that it might be applied to persons of all ages, and afforded greater facilities for the extraction of the stone, yet these were insufficient to redeem the inconveniences inseparable from

such a mode of proceeding. The external incision was nearly vertical, and hence, if carried down sufficiently far, must have divided the rectum. This, however, could have been easily obviated by lateralizing the incision. The vessels in the lower part of the perinæum were, it is true, avoided, but the external incision commenced over the spongy body, and hence the superficial artery of the perinæum, or the artery of the bulb, were almost always divided. This disadvantage likewise might have been avoided by opening, as some of the old operators did, the membranous portion of the urethra, and not the bulb. By commencing the incision too high there was considerable danger of infiltration of urine into the cellular tissue near the root of the scrotum.

These disadvantages are nothing compared to the one essentially connected with the manner in which an opening was made for the extraction of the calculus. This was effected by forcible dilatation of the prostate and neck of the bladder. Dilatation was the theory, but is easy enough to see that laceration must have been the practice. The fact is that the whole of the canal from the opening in the bulb to the body of the bladder, that is to say, the membranous portion of the urethra, the prostate and neck of the bladder were more or less contused, lacerated, and injured in a frightful manner.

Le Dran made a great number of experiments on the dead body to determine the effects of this forcible dilatation. Having incised the membranous part of the urethra, he dilated the prostate and neck of the bladder, but not enough to allow the passage of a moderate

sized calculus. He then carefully examined the parts, and found that the urethra and neck of the bladder had been completely torn across; the prostate remained intact.

He repeated the experiment on other bodies; the dilatation was carried to an extent sufficient to allow the finger to be introduced into the bladder along the conductor; the whole of the parts from the bulb to the bladder were now found to have been lacerated; the neck of the bladder appeared as if it were completely separated from the prostate, which was split into two parts. When the same degree of dilatation was however effected in a very slow manner, the body of the prostate escaped laceration.

Those who may have had the misfortune to witness a case of forcible dilatation, even after free division of the parts in the lateral operation, can alone estimate the sufferings and danger to which the patient must be exposed from the Marian method. We know that cases of the lateral operation have occurred where the patient has been kept an hour on the table, the surgeon all the while sweating and labouring like a bricklayer, tearing the parts in all directions, bending or even breaking his forceps, and at last obliged to abandon the operation in despair. Such things have occurred, and if they do sometimes take place even after free division of the prostate, what must be the result when the surgeon attempts to obtain anything like a large opening for the passage of a calculus by simple dilatation? Instead of dividing the parts with the knife, he must lacerate them with blunt instruments. With the knife he can limit

incisions ; but with the dilator he can never limit the degree of laceration ; the effects of such injury I need hardly enumerate. Chloroform may indeed guarantee the patient from pain and its consequences ; but the almost inevitable effects of tearing asunder the prostate and bladder are obvious. The lacerated parts inflame, abscesses form between the layers of the pelvic fascia ; urinary infiltration takes place ; in short all the secondary accidents which render lithotomy fatal, must soon supervene in an aggravated form ; and if the patient be so fortunate as to escape these he labours for the rest of his life under an incurable incontinence of urine, produced by over distension or laceration of the tissues about the neck of the bladder. Besides these defects, which are sufficient in themselves to make us reject the operation, it is clear that the surgeon is compelled to extract the stone towards the angle of the pubes, instead of downwards in the direction of the axis of the pelvis. On this account he must experience great difficulty during the extraction of any calculus which exceeds a moderate size.

It may appear rather superfluous that I should dwell on the defects of a method which has been abandoned for more than a century, but the laudable desire, to which I have already alluded, of rendering lithotomy less fatal than it commonly is, has induced surgeons from time to time either to return to ancient methods of operating or suggest new ones.

In 1727, Dr. Douglas published a paper in the "Philosophical Transactions," which concluded with a suggestion that the urethra might be opened in the peri-

næum and dilated so as to extract any stone without cutting the bladder or lacerating the structures concerned in the operation.

This hint does not seem to have given rise to any attempt at applying the principle in practice. The subject was again taken up in 1796 by Deschamps, who proposed what he denominated a mixed method, resembling the lateral operation in the external incisions, and resembling the Marian method in dilatation of the prostate and neck of the bladder. Deschamps suggested that the integuments, &c., should be divided obliquely until the knife reached the membranous portion of the urethra; this was opened, and the prostate slightly nicked, after which the parts were dilated, as in the Marian method, but in a very slow and gradual manner. It is curious to find the celebrated French lithotomist exclaiming, "Who knows but at some future time surgeons may not be tempted to return to this method?"

I have already said how they were so tempted. In 1819, Sir Astley Cooper extracted a stone as large as a walnut by this mixed method; in 1830, it was advocated by Dr. Buchanan, of Glasgow, and in 1842, it was again brought forward by Dr. Willis.

Although the dilatation was conducted in these cases much more slowly than even Deschamps recommended, yet the method had merely time to be baptized with a new name, lithectacy, when it died a natural death, and no one will probably be tempted to revive it.

Deschamps conceives that his mixed operation may be applied in a few cases, where the prostate is so completely enveloped by the rectum that any division of

the gland according to the lateral method must inevitably compromise the gut. In illustration of this he relates an interesting case of dislocation of the femur after hip-joint disease, in which the prostate was pushed towards the left side and completely buried in the rectum. It would have been impossible to divide any portion, however limited of the gland, without injuring the intestine.

Although the Marian method was nothing better than a clumsy dilatation, or, to speak more correctly, laceration of the prostate and neck of the bladder, it was not always attended by such fatal results as one would naturally infer it would have been. Morand published an account of all the operations performed according to this method at the Hôtel Dieu and La Charité in Paris during a certain time. Of 812 patients operated on 557 were cured, and 255 died, being a mortality of one in $2\frac{1}{5}$; on the other hand, Le Dran pretends that, in the years 1728 and 1729, he cut sixteen patients without losing a case; but it is right to remark that Le Dran dilated much more cautiously than any of his contemporaries who employed the apparatus major.

The high or supra-pubic operation consists, as its name indicates, in opening the bladder above the pubes.

Here the organ might be reached with perfect safety, were it not for the circumstance of its being in close contact with the peritonæum. I need hardly remind the reader that the peritonæum, having descended along the anterior wall of the abdomen to the level of the symphysis pubis, passes inwards over the apex of the bladder, and then descends for a certain way behind

that organ until it approaches the rectum, when it is reflected upwards. Nearly the whole of the anterior wall of the bladder is thus uncovered by a peritonæal lining, and if the upper part of the bladder in its natural state were situated in the abdomen instead of the pelvis, nothing would be more easy than to open it by cutting down between the pyramidal muscles.

In ordinary cases, as I have said, the bladder is more or less concealed behind the pubes, but its loose connexion with the bones permits of its occasionally ascending into the abdomen. This change of position will chiefly depend on the bladder being empty or distended with fluid; but it may also be influenced by several other circumstances. When the organ is completely empty, it naturally sinks into the pelvis, and the same effect will be produced by any irritating cause, as stone, &c., which excites powerful contraction of the organ. On the other hand, the apex of the bladder rises somewhat above the level of the pubes in children, whenever the bladder is distended with urine or other fluid, and whenever, from any circumstance, it has acquired a tendency to dilate in a ready manner.

Whatever predilection we may have for the lateral operation, we are nevertheless compelled to acknowledge that it is sometimes impracticable—sometimes, as in cases of very large stone, attended with such imminent danger that some other mode of operating must be had recourse to. Thus it may be impossible to introduce a grooved-staff into the bladder; it may be impossible to separate the patient's legs and place him in the proper posture. This sometimes arises from contraction of the muscles after paralysis or rheumatism. The peri-

næum may be obstructed by tumours, &c., or the outlet of the pelvis may be so contracted or deformed, that the extraction of a calculus by the lateral operation becomes impracticable. In all cases of this kind we must seek for some other mode, and the majority of surgeons appear to agree in thinking that the apex of the bladder, or rather the upper part of its anterior wall, is the preferable part to open. Indeed Dupuytren goes so far as to affirm that were it not for the danger of peritonitis, the high operation should take the place of all others as a general method.

To perform the high operation with any chance of success two points must be attained. The bladder must be raised above the level of the pubes in such a manner as to present a portion of its anterior wall uncovered by peritonæum; and the infiltration of urine into the sub-peritonæal cellular tissue must be prevented.

The different modes of attaining these two objects have given rise to two different ways of performing the operation. Sometimes the bladder is elevated above the pubes by injecting a quantity of fluid into it; sometimes it is raised up with a sound, and perforated with a sonde à dard. To avoid the risk of infiltration of urine, an opening was in one method made into the perinæum; while in the other, the operator contented himself with introducing a catheter through the urethra.

The high operation for the extraction of stone presents many advantages and some disadvantages, which are peculiar to it; but it is by no means easy to draw a fair parallel between the two, from modern practice at least, because the operation is now ex-

clusively reserved for difficult cases, to which the surgeon either cannot or dares not apply any other method.

The great advantage of the high operation is this, that it enables us without any dangerous laceration of parts, or without carrying our incisions beyond prudent bounds to extract calculi that are too large to come out beneath the pubes. It is also said to be a valuable resource in cases where the calculus is impacted in the neck of the bladder or partially encysted in the floor of that organ, behind or to the side of the prostate.

It is clear that with one exception, viz., the danger of wounding the peritonæum, the high method is free from many of the accidents connected with the lateral operation. The incision of the bladder is made at a point which is not surrounded by complicated and delicate structures, such as the urethra, prostate, and neck of the bladder. There is no fear of laceration of parts; nor any danger at all similar to that arising from too free division of the prostate for the extraction of a large calculus. Dangerous hæmorrhage is also avoided, because the incisions are made in the median line; a few cases however have terminated fatally from bleeding.

The rectum and vesiculæ seminales with their ducts are, of course, out of the way of danger, and the patient runs no risk of being afflicted with the incontinence of urine or perinæal fistulæ which are so frequently the consequences of violent efforts to extract large calculi through the neck of the bladder and perinæum.

The obstacles to and accidents of the high operation are not without weight, although many of them depend on the peculiar nature of the case rather than on the

operation itself. Thus, for example, when the patient is extremely fat the same effect is produced as when the perinæum is excessively deep. The distance of the surface in both cases from the cavity of the bladder renders it difficult to seize the stone or bring it within the grasp of the forceps.

When the bladder is much thickened, irritable, and contracted—and I have already explained that this frequently occurs when the stone is large—the bladder is situated low down in the pelvis; it is difficult to make it ascend above the brim of the pelvis; the peritonæum remains applied close over the inlet, and the serous membrane runs much risk of being divided, while it becomes difficult to incise to a sufficient extent the anterior wall of the bladder which is concealed behind the symphysis pubis; neither forced injections nor the sonde à dard of Frère Come are sufficient to overcome this obstacle in a complete manner. Forcible injection, if carried far, is very painful and not unattended with danger, for Cheselden relates "how the bladder was sometimes burst both at St. Thomas's and St. Bartholomew's Hospitals." Besides when the bladder rises very high, the peritonæum does not ascend proportionately, but loops upwards, and the operator may be easily deceived. On the other hand, if we follow Come's method, instead of injecting, the space between the peritonæum and the pubes is very small, and a difficulty may arise from the bladder sinking down into the pelvis as soon as it has been opened with the bistoury. Should the calculus be large and the bladder closely contracted over it, the operator may find it quite impossible to pass the sonde à dard between the stone and walls of the bladder

so as to reach the supra-pubic space; and even when the bladder has been sufficiently divided, it is by no means easy on account of the direction of the incision, to seize and extract the calculus; the forceps do not work with the same facility as when they are introduced through the perinæum. This is one of the principal reasons which would induce me to reject the high operation even for cases of very large calculi. In almost every case of this kind the bladder is thickened, contracted, and incapable of distension above the pubes; and no instrument can be introduced through the urethra or perinæum to assist in elevating its anterior wall to the level of the incision.

The only two accidents essentially connected with the high operation are injury of the peritonæum and infiltration of urine, causing either peritonitis, or inflammation and abscess in the cellular tissue of the pelvis. I have already explained how the difficulty of elevating the bladder above the edge of the pubes leads to the risk of the serous membrane being divided. This accident occurred twice in the hands of Cheselden himself, and the best operators have not been able to avoid it. However it does not always terminate fatally. Infiltration of urine into the pelvic cellular tissue is a more frequent accident than the former and little less dangerous. At first sight one might be inclined to think that as the incision is made into the upper part of the bladder, the urine would have a tendency to escape rather through the urethra or the opening made in the perinæum; but this is not the case. The adhesion which soon takes place between the wound in the bladder and the walls of the abdomen converts the

external wound into a point or centre towards which the contractile force of the bladder acts, and the urine has a constant tendency to take this course. But this adhesive inflammation has at the same time the effect of preventing to a great degree infiltration of urine into the cavity of the abdomen or the cellular tissue of the pelvis.

These considerations are sufficient to justify the conclusion that the high operation can never replace the lateral one as a general method, but should be confined to those exceptional cases in which it is impossible or excessively dangerous to extract the calculus through the perinæum.

To estimate the value of the high operation from statistical data it would be necessary to take a series of cases in which it was employed as a general method, such as those of Douglas, Cheselden, Middleton, &c. Cheselden pretends that he lost only one out of every seven patients; but as he informs us that he excluded from this calculation two cases which proved fatal from wound of the peritonæum, it is clear that the proportion of his success must be considerably abated.

Mr. Humphry, surgeon to Addenbrooke Hospital, Cambridge, has published a successful case of the high operation, and given a statistical account of 104 cases from the practice of various surgeons; 31 of these cases proved fatal, being a mortality of 1 in $3\frac{1}{3}$. Peritonitis and infiltration of urine were the most frequent causes of death noted in Mr. Humphry's table. These cases were probably taken from the same source as those given by M. Belmas, who collected 100 cases, showing a mortality of 25, or 1 in 4. M. Souberbielle in a me-

moir presented to the French Academy of Medicine, states that he lost 10 cases out of 50, or 1 in 5 ; while, in another publication, he confesses having lost, in two years, 18 patients out of 52, or something more than 1 in 3.

It should, however, be remarked that a great number of these cases, and also of those recorded in M. Belmas's table were extremely serious cases, to which the lateral operation had been judged inapplicable.

The introduction of the bilateral operation is due to one of the most distinguished surgeons of the French school. Like many of his predecessors, Dupuytren was induced to reflect whether the inconveniences hitherto inseparable from all attempts to reach the bladder below the pubes might not be avoided. On examining the relations of the space to which I have already alluded, extending from the surface of the perinæum to the neck of the bladder, he found that the available portion of the external incision did not exceed from fifteen to twenty lines, while the distance of the neck of the bladder from the tuber ischii was somewhat less, yet it is this latter distance which we must take as the measure of the available extent we can give to the incision of the soft parts.

Now, if we make this incision as large as it is susceptible of being made (and that in order to facilitate the extraction of a large calculus), we divide the neck of the bladder and the whole thickness of the prostate ; we fall on the cellular tissue of the pelvis, and expose the patient to all the dangers which accompany infiltration of urine. Such an incision also exposes us to the dangers of dividing the superficial artery of the

perinæum, the transverse artery, sometimes even the internal pudic, and in all cases, the rectum.

If, to avoid these dangers, we make but a very small incision, we avoid, it is true, the vessels and the rectum, but we have great difficulty in manipulating with the forceps or extracting the stone; and if the latter be large, we inevitably contuse or lacerate the parts in a dangerous manner.

Some of these inconveniences may be avoided by commencing the incision high; but then we run the risk of dividing the artery of the bulb, and gain nothing for the opening into the bladder.

If the incision, on the other hand, be commenced low down, the parts just named are avoided, but on continuing the incision to a sufficient extent, it may involve the internal pudic artery or the rectum.

It may be said, perhaps, that there is a medium between these extremes; this is true, and all good operators endeavour to attain it; but here lies the difficulty. To attain the end with certainty it would be necessary that the stone always preserved the same proportion to the parts through which it passes; this, however, is not the case, and hence in endeavouring to avoid one inconvenience, we fall into another.

Having examined the various ways in which the prostate might be divided so as to avoid as many as possible of the accidents now enumerated, Dupuytren conceived the notion of dividing the prostate on both sides, and thus avoiding the danger of free incisions when practised on one side only. Louis had already shown how the neck of the bladder might be advantageously divided on both sides in lithotomy in the

female, and it only remained to be seen how far this principle might be applied to the male. Dupuytren might also have remembered that both Le Dran and Deschamps had not only recommended, but actually practised, this double division of the gland in cases of large stone.

The only safe way of making this double incision is to direct it obliquely downwards and outwards on both sides, and this Dupuytren effected with his double lithotome caché in the manner which I have already described.

The advantages which Dupuytren attributes to this method are the following. It is quicker and more easy than most other methods, and just as safe. The incisions are made at the widest part of the outlet of the pelvis. It takes the most direct route from the surface of the perinæum to the cavity of the bladder, and thus facilitates the introduction and working of the forceps, the extraction of the stone, and the discharge of the urine. It enables the operator to make his incisions proportionate to the size of the stone, better than any other method. The lateral incision gives an opening which allows a spheroidal body, thirty-four lines in circumference, to pass out; the bilateral incisions give one which admits the passage of a sphere forty-eight lines in circumference, besides the gain of dilatation on both sides instead of one. Hence the chance of contusion, laceration, &c., and their evil consequences are more surely avoided. It is exempt from the danger of hæmorrhage, and it avoids in a certain manner the seminal ducts and the rectum.

This is a brilliant picture, but it has been drawn by

the inventor of the method, and surgeons, like other men, are not exempt from the failing of looking with admiration on their own works. We must, I fear, abate somewhat from Dupuytren's estimate.

I do not believe that the bilateral method is either easier or quicker, under ordinary circumstances, than the lateral operation. I have myself, more than once, extracted a good sized stone in less than a minute by Cheselden's operation, and I do not imagine that the double lithotome can work much faster with advantage. It is certain also that the bilateral method does not entirely exempt the patient from the danger of hæmorrhage. Dupuytren, Sanson, and others, have lost patients from bleeding. Professor Eve wounded the rectum in one of his operations, and when the perinæum is very deep it becomes difficult to pass the beak of the double lithotome into the bladder. It is not, besides quite certain that the double-bladed instrument gives a regular incision on both sides of the prostate gland, and it is likely, without great care, to divide even the neck of the bladder Its principal advantages are, that it avoids the rectum and seminal ducts, and affords a free opening for the extraction of large calculi. This is a great advantage, which in modern practice we endeavour to obtain by dividing the right side of the prostate, wherever we think the incision on the left side alone will not afford sufficient space for the extraction of the calculus ; we often, in fact, perform the bilateral operation with this difference, that the external incision is Cheselden's, and the one on the right side of the prostate is not, perhaps, so safely or so methodically made as in Dupuytren's method. Mr. Liston thought

it was quite time enough to divide the other side of the prostate when we found such a proceeding to be necessary, and this is the practice now followed in this country.

Let us now test this method as we have done others, by its results. Dupuytren's own practice does not give a very favourable view of it as a general method, yet he spared no efforts to show it in a bright light. It is well known that he used to divide all his calculous patients into three classes; those with large calculi he sent to his colleague, M. Sanson, for the recto-vesical operation; the doubtful cases he used to send to M. Breschet; and all the good cases he kept for himself. In spite of this Dupuytren lost 9 male patients out of 38 on whom he operated, being a mortality of 1 in $4\frac{1}{4}$; but if we exclude children, and take adults from 20 to 70 years of ages, we find that he lost exactly one half his patients, or 7 in 14; this is not a very flattering result. Of 47 operations performed by M. Sanson, Roux, Velpeau, and Blandin, 10 proved fatal; and these gentlemen were not more fortunate than Dupuytren with their adult cases, for of 19 adults, from 20 to 72 years of age, 9, or nearly one half, died.

Professor Eve, of the Nashville University, in the United States, has kindly favoured me with an account of 22 cases in which he performed the bilateral operation; only 4 patients died, giving a mortality of nearly 1 in 6; but here again we find the influence of age. Only 7 of the patients were adults, viz., 4 under 30; 1 of 50; 1 of 65; 1 of 77 years, and out of the 7, 3 died.

M. Sanson, of the Hôtel Dieu, brought out his recto-

vesical operation some few years previous to the proposal of the bilateral method. It was warmly taken up by Dupuytren, who employed it in 10 or 12 cases; pronounced it to be the easiest, quickest, and least dangerous of all methods, and predicted that it would reduce the mortality of lithotomy to 1 in 8. The favourable opinion of Dupuytren has not been adopted by other surgeons, and the recto-vesical method is now, I believe, entirely abandoned. According to M. Sanson, the advantages of his method are the following :—it is easily and quickly performed, two strokes of the bistoury complete the incisions; there is no danger of hæmorrhage, some branches of the hæmorrhoidal artery alone being divided; the largest stones can be extracted without much difficulty; there is little danger of infiltration of urine, and the cavity of the bladder is easily reached. A great number of objections have been made to this operation, but the only serious one is the liability of its being followed by incurable fistula. Yet this has been overrated, for the statistics of the operation show that it does not occur more than once in 5 times. Of 14 patients operated on at the Hôtel Dieu, 3 died; in 71 operations performed in Lombardy, 14 proved fatal; and Vacca operated on 61 patients, of whom 11 died. The general mortality was thus 1 in 5. In the facility of performance, &c., and freedom from danger, it is preferable to the high operation; but, as I have said, it is subject to the serious disadvantage of exposing the patient to an incurable fistula.

The lateral operation is now universally adopted, not only in this, but in all other countries, and hence we have a *primâ facie* reason for concluding that as a

general method it is the best. I cannot affirm that it is perfect, but on comparing its advantages and disadvantages, we shall find that it possesses more of the former and less of the latter than any other method which has been hitherto devised.

Cheselden's operation, in the ordinary run of cases at least, is quick, easy, and simple. It is a great advantage to be enabled to perform an operation with a small number of instruments; to have nothing which may complicate our proceedings or distract our mind, and the lateral operation requires nothing but a staff, knife, and forceps. When nothing untoward occurs, it may be performed in a minute or so, and for quickness it certainly surpasses the high and bilateral methods, and even the recto-vesical.

The external incisions are made with rapidity, and the internal incision presents no difficulty of any importance. I speak now of simple cases; an unpractised hand might, perhaps, find some difficulty in running the sharp point of the knife rapidly along the groove of the staff, but this is avoided by the use of the button-headed bistoury, which cannot slip out of the groove. The extraction of the stone is the part of the operation which is attended with the greatest difficulties. Some of these are common to other methods, while some are peculiar to the lateral operation. The most usual of these latter arise from the position of the stone, caused by enlargement of the prostate, or from the calculus being hooked above the pubes. In such cases the difficulty which is common to the lateral and bilateral operations becomes much less if the bladder has been opened above the pubes, or through the rectum. It is

also easier to reach an encysted stone through the incision above the pubes. Excessive depth of the perinæum may render it a matter of difficulty to reach the stone through the lateral or bilateral incisions; the recto-vesical method is of course free from this disadvantage; but an analogous obstacle is much more likely to occur, from an accumulation of fat in the walls of the abdomen, in the suprapubic operation.

The size of the stone is the grand difficulty in the lateral as well as in all other methods, and I shall therefore examine this point apart.

Let us now turn to the accidents to which each operation may give rise. Those of the lateral operation are hæmorrhage; wound of the rectum, and inflammation of the various tissues excited by urinary infiltration; I omit the shock and some of the accidents which are common to all methods.

In describing the manual part of the lateral operation, I explained how the occurrence of hæmorrhage might be avoided by incising the parts with a due regard to the natural position of the several arteries which are liable to be divided. It is unnecessary to recur to this point. Hæmorrhage of a fatal kind is now of rare occurrence in the practice of English surgeons. In more than 100 cases Mr. Liston only had one misfortune of the kind. Still the arteries of the perinæum are numerous, and lie close to the knife in all directions; they are subject to variations in their course, and it is evident that the oblique incisions of the lateral method must expose the operator to greater risk of dividing an artery than the median-line incisions of the high or rectal operations.

Wound of the rectum is another occasional accident of the lateral operation. This is rare now a days ; it has occurred in the bilateral method, and it forms part of the proceeding in the recto-vesical operation ; but it bears no proportion in seriousness or frequency of occurrence, to the wound of the peritonæum in the high method.

Nearly one half of the patients who die after the lateral operation, are cut off by inflammation of the parts about the neck of the bladder, sometimes extending to the peritonæum, and to the bladder itself, but much more frequently to the cellular tissue of the pelvis and the sub-peritonæal cellular substance. This inflammation may be excited by mere contusion or laceration of the parts, but it generally arises, I believe, from infiltration of urine into the cellular tissue between the different aponeuroses of the pelvis, and this again is connected with the great, I might almost say, the only defect of the lateral operation.

The internal incision must be, in some degree, proportioned to the size of the calculus. It must be sufficiently large to permit the extraction of the stone after a certain amount of dilatation ; but it must never pass beyond the limits of the prostate. The surgeon is thus perpetually placed between the dilemma of laceration of parts and infiltration of urine. No matter how experienced or dexterous the operator may be, it is extremely difficult to divide the prostate to the exact extent which he desires ; to say, if I may borrow the expression, "thus far shalt thou go and no further."

He has nothing to guide him but the sensations communicated through his hand ; yet as the consistence of

the prostate varies in almost every subject, the degree of pressure must vary also, and hence the great difficulty of limiting the internal incision, as Liston and modern authors enjoin us to do, to seven or eight lines; an error of a few lines may bring us beyond the capsule of the prostate and infiltration of urine is the almost inevitable consequence.

The danger of which I now speak only occurs when the calculus is suspected to be large. The operator must then either incise freely or dilate freely; in the one case he exposes the patient to inflammation from laceration, in the other case he exposes him to inflammation from infiltration of urine. How often does it occur that the operator fancies that he has to deal with a large calculus, when the stone is really small, or where he is deceived by the presence of two or three small calculi, which simulate a large one?

The patient is in good health and everything promises well, a free incision is made, and the operation completed in a few minutes; but things change in a day or two; unfavourable symptoms set in, for infiltration of urine has taken place, and the result is death.

The imperfection then of the lateral operation is, that it is not well suited for the extraction of large calculi. It is true that we may remedy this disadvantage, but in doing so, we change the character of the operation altogether; in fact we pass from one method to another. When the calculus is of such a size that the operator is unable to extract it through the lateral incision without using undue force, or enlarging his incision to a dangerous extent, two courses are open to him; he may divide the opposite side

of the prostate, or if this prove insufficient, he may break up the stone with the lithotrite, or a pair of strong forceps. In either of these cases he no longer performs the lateral operation. In the former he performs the bilateral operation of Dupuytren; in the latter case he has recourse to perinæal lithotrity; he crushes the stone with an instrument introduced through the perinæum instead of through the orifice of the urethra.

Hence it is clear that the bilateral operation, that is to say, division obliquely downwards and outwards of each side of the prostate, is better suited for the extraction of large calculi than the single lateral operation. But as very large calculi do not present themselves more than once in several hundreds of times, the lateral operation must remain, as it now is, the general method for the extraction of urinary calculi.

A very large stone cannot be extracted through the perinæum, it must be broken, and the only question which remains to be decided is, whether the difficulty and danger of extracting it by fragments are not greater than if the foreign body were removed above the pubes, or through the rectum? I have already said that I believe it to be just as dangerous to extract a very large stone above the pubes as it would be to break it, and the results of the recto-vesical operation are not sufficiently encouraging to induce me to recommend it under any circumstances.

The mortality of the lateral operation contrasts strongly with that of the other three methods, and this is the last argument which I shall adduce in proof of its superiority. We have seen that the bilateral ope-

ration give a mortality of 1 in $4\frac{1}{2}$; the recto-vesical 1 in 5; the high operation 1 in $3\frac{1}{3}$.

Now the lateral operation, as practised by Cheselden, gives a mortality of 1 in $10\frac{1}{2}$; by Liston, of 1 in $7\frac{1}{5}$; at St. Thomas's Hospital, 1 in 9.

These statistics speak for themselves, and show that if British surgeons give less *eclát* to their operations, they are superior to their neighbours in the essential element of success; for it is no small triumph to be enabled to say, that we save nearly twice as many patients whom we cut for stone, as the best operators of the French school of surgery.

CHAPTER XVI.

URETHRAL LITHOTOMY.

CALCULI are sometimes, though very rarely, developed in the urethra; when found in that organ they have commonly descended from the bladder, or been formed by fragments which become impacted in the urethra after an operation of lithotrity.

In discussing the treatment of this latter accident, I mentioned that when all efforts to extract the fragment or calculus by mechanical means have failed, we must have recourse to the knife. The operation thus performed with the cutting instrument may be called Urethral Lithotomy; and as it is the same whether it be had recourse to after lithotrity, or for the removal of an unbroken stone; the same description will answer for both.

The operation presents some differences according to the seat of the calculus or fragment in the urethra. The foreign body may be lodged in or near the neck of the bladder; in the membranous portion of the urethra, or in its spongy portion anterior to the scrotum, at any point from the root of the scrotum to the fossa navicularis.

The calculus, or a large fragment, may become impacted in the neck of the bladder itself. This is a very serious accident, and may give rise to symptoms which are often more distressing than even those of urinary calculus. When the neck of the bladder is completely obstructed by the foreign body, retention of urine of course takes place, and an additional reason exists for relieving the patient from his malady without delay.

It does not enter into my plan to describe the symptoms which accompany the impaction of stone in the neck of the bladder; I can only notice the operative proceedings suited to such a case. It is, fortunately, a rare one, for when the calculus is prolonged into the

Fig. 97.

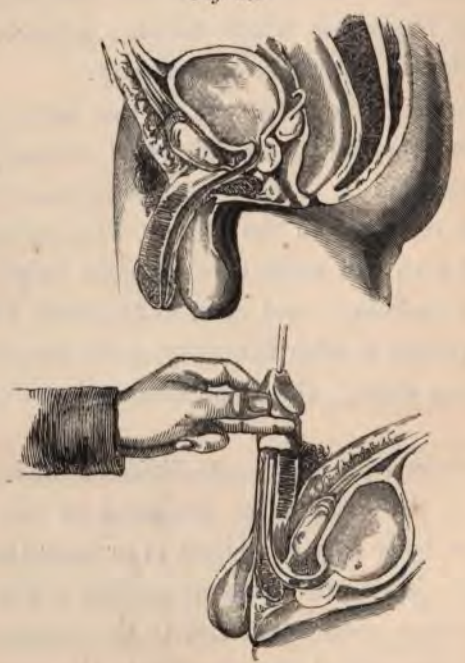


Fig. 97.—Sections of the urethra.

prostatic or membranous portions of the urethra its extraction is one of the most difficult and embarrassing operations in the range of operative surgery.

Let us suppose that after careful examination through the urethra and rectum, we have ascertained that a calculus or large fragment of stone is impacted in the neck of the bladder and prostatic portion of the urethra; what proceeding should the surgeon adopt? I have presumed that he is unable to push it back into the bladder, and to avoid useless repetition, I may here repeat that what I am about to say applies only to cases in which extraction of the foreign body by external incision becomes inevitable, all other means having failed.

The calculus, and still less, the fragment of calculus, after lithotrity, does not always completely obstruct the natural passage; and hence two series of cases may be distinguished. In one series no instrument of any kind can be passed into the bladder between the foreign body and the walls of the urethra. The natural passage is completely blocked up. In the other set of cases a small grooved-staff, or a curved-grooved director, can be introduced into the bladder, either through the orifice of the urethra, or through an incision made into the membranous portion of this canal.

The operation applicable to the last series of cases is simple enough, unless, indeed, some unexpected accident intervene, and of this we can never be sure. The main point is to have a guide for the knife, and this the grooved-staff furnishes. Having passed the staff into the bladder, we proceed nearly in the same way as during the lateral operation. The external incisions

are the same ; the membranous portion of the urethra is next opened on the groove of the staff, close to the anterior prolongation of the calculus if it has extended so far ; all this is easy enough ; but now come the difficulties ; the staff may have passed to the right side of the calculus, or above it, &c., instead of the left side, and our guide is lost. Should this occur the operator must withdraw the first staff and pass a small one through the posterior part of the internal incision into the bladder, between the left side of the calculus and the wall of the canal ; this done, he divides the prostate with the knife conducted along the staff, until a sufficient opening is obtained. The anterior portion of the calculus is now to be seized with a small forceps and extracted. From its peculiar shape it is often difficult to obtain a firm grasp of it, and should any difficulty arise from this cause, an attempt may be made to pass a hooked instrument behind the posterior portion of the stone. This part of the operation will be facilitated by introducing the finger into the rectum, but if all our efforts fail to extract the foreign body, it must be pushed back into the bladder, and the operation terminated, as if it were the simple lateral one.

In the first series of cases, where no staff can be passed through the urethra into the bladder, the operation becomes very difficult and hazardous. Many writers on lithotomy recommend the following method ; a grooved-staff is to be introduced into the urethra as far as it will go, that is to say, as far as the calculus ; an incision is next carried down on the extremity of the staff, and an attempt made to pass a conductor from the opening in the membranous part of the ure-

thra into the bladder. Deschamps affirms, that by using some force a curved director with a bulbous extremity can always be introduced. If this can be done, the prostate is divided on the director, and the operation terminated as before mentioned.

Should every attempt to pass a staff or director fail, we are told that nothing is left but to perform Celsus's operation. The external incision must be free and directed obliquely towards the tuber ischii, in the usual manner; two fingers of the left hand, well oiled, are passed into the rectum, for the purpose of pushing the stone forwards, if possible; when the external incisions have been carried down to the membranous portion the operator introduces the right fore-finger into the bottom of the wound, and with it explores the position, extent, &c., of the prostate; this done he presses the point of a strong sharp knife through the posterior part of the gland, until it meets the calculus, and then divides the sides of the gland in the best way he can, from behind forwards and from above downwards. Should the opening thus made prove too small it must be enlarged on a small grooved-staff, and the stone extracted with a forceps somewhat like the one employed for the removal of polypi.

Such is the description of an operation which the best writers have not hesitated to recommend. For my own part I should never think of having recourse to it. The prostate must be hacked in a dangerous manner by such incisions, and would, probably, be lacerated more or less during the extraction of the stone.

For difficult cases of this kind it may be a question whether the recto-vesical and high operations, would

not be preferable to incisions made through the perinæum.

Dr. Macgill, of Edinburgh, endeavoured to extract a calculus impacted in the neck of the bladder by the high operation; he found it, however, impossible to dislodge the stone; the attempts were repeated on the seventh day and also failed; the patient survived to the thirteenth day, and after his death the calculus was found to have been so firmly wedged in the neck of the bladder and prostatic portion of the urethra, that no operation of any kind could have possibly enabled the operator to dislodge it.

The extraction of calculi, or of fragments, by incision, from other portions of the canal, can seldom be attended with any difficulty. The left index finger passed into the rectum will, in most cases, serve to fix the calculus when seated in the membranous portion, and the parts are here so superficial that we can easily cut down on the foreign body. If a staff be introduced it is necessary to go to work very cautiously, for this portion of the canal is readily lacerated. The occurrence of urinary fistula is the only accident which is likely to occur; but even this seldom supervenes unless the stone has been lodged for a considerable time in the canal, and produced ulcerative perforation of its walls.

The impaction of calculi in the spongy portion of the urethra often gives rise to very severe constitutional irritation, and hence, after lithotrity especially, they should be removed as quickly as possible. Here there is no difficulty whatever in cutting down directly on the median line, and making a sufficiently free opening

for the extraction of the calculus. The operation was clearly explained by Celsus, and has been performed since the very infancy of surgery.

The only addition of any importance which modern surgeons have made, is relative to the necessity of caution in all cases where the calculus is seated in that part of the spongy portion which corresponds to the scrotum.

Deschamps particularly insists on the danger of infiltration of urine and urinary abscess, if we divide that part of the urethra which is covered by the scrotum, and he therefore advises us, if possible, to push back the foreign body into the membranous portion of the urethra, and cut down on it there. Mr. Liston repeats the same advice, and explains the difficulty of healing a wound made anterior to the scrotum, by calling to mind that the coverings are here very thin. Deschamps, however, says that he never saw the incision followed by infiltration of urine unless the wound was made quite close to the scrotum, and the case an old one. A middle-sized catheter should be allowed to remain in the bladder for several days, if it can be borne; but if the incision has been made for the extraction of a fragment after lithotrity, very great caution must be observed about leaving any instrument permanently in the bladder. That organ has, in all probability, been more or more less irritated, not merely by the operation, but by the retention of fragments, and it is desirable to avoid any other source of irritation as much as possible.

CHAPTER XVII.

AFTER TREATMENT.

THE description of the operations for stone would be incomplete if I omitted all account of the treatment which is to be pursued until the patient has become convalescent.

When everything has gone on well during the operation, the after treatment is excessively simple. The surgeon has little more to do than to remain on his guard and allow nature to complete the cure.

And here I cannot avoid mentioning—because it is not generally known, or has been forgotten—that we are indebted to Frère Jacques for having got rid of the cumbrous dressings with which surgeons previous to his time were accustomed to irritate the wound and annoy the patient. Frère Jacques rejected all dressings of this kind, and his practice, though it excited much controversy at first, was soon adopted, and has ever since been followed.

The first few days which follow the operation of lithotomy are always an anxious time for the surgeon. However well the operation may have been performed,

however favourably the case may appear to be going on, we can never be certain that some untoward symptom, especially hæmorrhage, may not unexpectedly set in; and hence, if it be possible, the patient should never be left without an attendant for the first five or six days, strict orders being given that if the face becomes pale, or any unusual quantity of blood be detected on the bed-clothes, the surgeon should immediately be sent for.

The first thing to be done after the operation, is, of course, to have the patient carried to bed, and the main point is to keep him as quiet as possible, separated from the other patients, if he be in an hospital, and out of the way of all noise or disturbance if he be a private patient. It is, however, extremely difficult to keep children perfectly quiet in bed. Some surgeons advise us to elevate the shoulders and loins as much as can be done without inconvenience in order to give a depending position to the wound in the perinæum, and thus promote the discharge of urine. I do not employ this method myself, because the patient soon gets uneasy, and is liable to slip down. I prefer laying him flat on his back, with the knees slightly raised; the surface of the wound itself requires no application whatever, but the parts must be kept clean and dry by removing the napkins or sponges, if we use them, whenever they are wetted by the urine.

Some surgeons are in the habit of tying the knees together, under the idea that the sides of the wound are thus brought into contact; but it is not easy to see what advantage there is in this, since urine must flow through the wound for several days; besides we should

avoid, as far as possible, everything which may constrain or annoy the patient in any shape.

It is a matter of great importance that the urine should escape freely through the wound soon after the operation. The surgeon will pay particular attention to this point, but to ensure its attainment many are in the habit of passing a gum-elastic tube through the wound into the bladder, and securing it by tapes round the waist. This practice was first adopted by Collot; it was also followed by Deschamps, who says it is unnecessary to leave the tube in more than three days, since the edges of the wound are then consolidated. Amongst the moderns, Mr. Liston was a strong advocate of this practice; the tube is kept in for about twenty hours if the patient were a child; from forty to fifty hours if an adult.

This tube affords a ready exit for the urine, and prevents the wound being plugged up with coagula; it also assists in preventing the extravasation of urine into the cellular tissue of the pelvis, in cases where the internal incision may have been carried beyond the limits of the prostate; and it serves as a support for pledges of lint in cases of secondary hæmorrhage, should it be thought necessary to have recourse to compression. The only objection against it is, that the presence of a tube may increase any irritation or inflammation of the bladder which may have existed previous to the operation.

Perhaps a gutta-percha tube might be substituted with advantage for the gum-elastic one. The gutta-percha is much less liable to be acted on by the urine, or to receive any of those phosphatic deposits which

are thrown down so rapidly from the urine of an irritable bladder.

Should the patient experience any considerable pain about the neck of the bladder soon after the operation, an opiate may be administered, and this will further have the benefit of keeping the bowels quiet. They were freely evacuated before the operation, and it will seldom be prudent to move them before the third day, when a gentle dose of castor-oil may be administered. However, the oil may be given earlier if any pain in the abdomen or sickness at stomach be experienced.

For the first three or four days the diet must be very light, some tea and toast, milk and arrowroot, &c., with plenty of any bland fluid to drink; but the surgeon must bear in mind that children and very old people will require support at an earlier period than others.

The time at which the urine begins to flow through the urethra varies in almost every patient, sometimes sooner, sometimes later. Generally speaking, the wound is contracted a little about the fourth or fifth day, and then some urine begins to escape by the natural passages as well as through the wound. In one case on which I operated not long since, in St. Mary's Hospital, a considerable quantity of urine passed through the urethra on the morning after the operation. As the wound in the prostate continues to heal, more and more urine gradually passes through the urethra, and the quantity discharged through the wound diminishes in proportion, until at last the whole of the urine takes the natural route; from this time the external wound begins to close, and the cure is completed in about

thirty or forty days. On examining Mr. Crosse's table, however, of 504 cases, treated at the Norwich Hospital, I find that the average duration of the cases was forty-six days.

As the case progresses favourably towards a cure, the regimen may be gradually improved, some porter or even stimulants, being allowed according to circumstances.

All this is simple enough. In favourable cases the treatment is merely expectant, and anything like active treatment can only be called for by the accidents which supervene either during or after the operation.

Of the accidents which occur at the time of the operation the only one which I shall notice is hæmorrhage. We have already seen that the bleeding may come from various sources; from the artery of the bulb, if the incision has been commenced too high; from the superficial artery of the perinæum; from the hæmorrhoidal arteries, or from the pubic itself. It is almost impossible to conceive how the trunk of the pudic artery can be wounded during the lateral operation, provided the parts preserve their normal relations, but the superficial perinæal or hæmorrhoidal vessels may be easily divided. Still, when from the size of the stone, the surgeon is obliged to perform a bilateral operation, that is to say, divide the right side of the prostate, there may be danger of wounding the pudic artery, because the operator has no sure means of guiding his incision. Cheselden was in the habit of taking up the vessels as they were divided; and whenever the arterial bleeding is considerable, his

example should be followed. But it is by no means an easy matter to tie either the artery of the bulb or the trunk of the internal pudic artery. The one is hidden so deeply under the arch of the pubes, and the other so closely bound down by aponeurosis to the ischium, that it is almost impossible to discover their divided orifices, or reach them with the needle. A few cases, it is true, are recorded, where the surgeon was fortunate enough to take up the trunk of the pudic artery ; but these are exceptional, and I believe that pressure with the finger against the ascending ramus of the ischium is the only safe practice to which we can have recourse. It may be tedious for the assistant, and a source of annoyance to the patient, yet twelve hours may suffice to place the life of a man beyond danger, and no sacrifice is too great for such an object. It is unnecessary to mention that this pressure will also serve to arrest hæmorrhage from the artery of the bulb.

Secondary hæmorrhage may be either arterial or venous, and the blood may issue through the external wound, or it may find its way into the bladder, or the bleeding may take place in the cavity of the bladder itself.

It is very necessary to bear in mind the two latter circumstances, although they occur very rarely ; but if the patient show any signs of loss of blood, such as paleness, sinking, &c., the attendant should never fail to examine into his condition without a moment's loss.

The same general causes which give rise to secondary hæmorrhage after other operations, will also promote the occurrence of secondary hæmorrhage after lithotomy : there is no exemption in favour of the perinæum. But it is unnecessary to inquire into the physiological

causes of secondary hæmorrhage, our chief business now is to examine how we can arrest it.

Venous hæmorrhage may arise either in consequence of division of the bulb, an accident not easily avoided in old patients, or from division of the venous plexus which surrounds the superior and lateral portions of the prostate. Here we have no other resource than to apply pressure, and this is to be done either directly or by introducing pieces of lint round the tube of which I have already spoken. In other words, the wound must be plugged; yet this often gives rise to great irritation and other unpleasant consequences; besides which it is often inefficacious.

For secondary arterial hæmorrhage various modes of practice have been recommended. The most certain method would be to secure the mouths of the bleeding vessels, but this, for obvious reasons, can seldom be done.

The only resources available in practice are plugging the wound, applying pressure to the trunk of the main vessel, or cold applications to the surface of the body.

Many surgeons place their chief reliance on cold for the suppression of secondary hæmorrhage, and it is a means which should never be neglected, because if it do no good, it can do no harm; and this is more than we can say of many remedies. If the bleeding come from the arteries of the perinæum, ice should be applied to the wound; but if from the neck or interior of the bladder, the cold should be applied to the lower part of the abdomen. Deschamps, Chelius, and many other eminent surgeons, place great reliance on this practice.

In this country we are more inclined to adopt plugging. Dupuytren, Graeffe, and other surgeons, have invented particular instruments intended to arrest hæmorrhage by pressure, but the most simple and easy method is the one I have already alluded to. The wound should be plugged with pieces of lint, passed up round the tube or catheter; and if this fail, constant pressure must be exercised on the trunk of the pudic artery against the ramus of the ischium.

Hæmorrhage within the cavity of the bladder can only be combated by the application of ice to the abdomen, the use of cold injections, and any other means calculated to excite contraction of the bladder.

In calculous patients the bladder is often affected with chronic inflammation, or a more acute form may be excited by the operation. The appropriate treatment must here be employed; but it is not always easy to distinguish pure cystitis from the other inflammatory effects of lithotomy, they become so rapidly mixed up one with another.

Inflammation and sloughing of the cellular tissue of the pelvis, are, as we know, the most frequent and dangerous accidents which follow lithotomy. The symptoms are very insidious; the patient first complains of some heat and pain about the neck of the bladder, the pulse is small and weak at first, but soon becomes quick, the face expresses anxiety at a very early period, the tongue now becomes furred, the discharge from the wound gets fœtid; the abdomen is often tender; hiccup ensues; the patient falls into a state of prostration, and is usually cut off in a few days.

The treatment of such cases is seldom attended by

satisfactory results ; an attempt should be made to prevent any further infiltration of urine by keeping a gum elastic catheter in the bladder, and the patient's strength must be supported by nutritious food and stimulants. Anodynes will also be found useful, but antiphlogistic remedies only for the most part hasten death. Sir B. Brodie recommends us, in cases of this kind, to employ the same practice which we adopt for sloughing inflammation of the cellular membrane in other parts of the body. He advises us to lay open the sloughing abscess into the rectum, and continue the incision through the sphincter ani muscle. In one case related by Sir B. Brodie, this had a beneficial effect, but I cannot find that it has ever being imitated either by Sir Benjamin himself, or by other operators. For my own part, I could never recommend so severe a remedy. Deschamps long ago discussed the propriety of giving free exit for the extravasated urine by incisions, and showed how useless they were, inasmuch as the surgeon could never tell with any precision in what part of the pelvic cellular tissue the extravasation of urine and consequent sloughing had taken place.

Simple peritonitis, that is to say, inflammation of the serous membrane not produced by infiltration of urine into the sub-peritonæal cellular tissue, is a rare accident after the lateral operation, though not unfrequent after the high method. The pain and tenderness commence in the vicinity of the bladder, and thence extend over the rest of the abdomen, which becomes tense. The usual symptoms of peritonitis soon follow, and the patient generally dies on the third or fourth day. Whenever the surgeon has reason to think that he has

to do with primary peritonitis—and if the patient be a child the disease is commonly primary—he must employ active antiphlogistic treatment, with calomel and opium, and frequent fomentations to the abdomen.

Purulent infection of the blood, characterised, amongst other symptoms, by secondary deposits of pus in the joints or viscera, is another serious accident worthy of notice. It does not occur frequently here, though many examples are on record; while in France it is set down as one of the ordinary accidents of the lateral operation. M. Blandin mentions six cases which came under his own notice within a short space of time. I cannot explain this remarkable difference between the results of French and English practice in any other way than on the supposition that the French surgeons are in the habit, as I believe they are, of making very free incisions through the prostate, and thus involving the venous plexuses about that organ—hence phlebitis, and one of its frequent consequences purulent infection of the blood. This is a most fatal accident, but I have so fully discussed its nature, symptoms, and treatment in another work, that I shall not recur to them here.

The rectum is sometimes wounded during the lateral operation. If the intestine has been merely nicked by the point of the knife, it will often heal as the wound in the perinæum closes; but more extensive injury is apt to be followed by recto-vesical fistula. Surgeons are not agreed on the treatment of such an accident. Mr. Liston says the sooner the rectum is laid freely open by division of the sphincter ani the better; while the majority of practitioners seem to think that we had better leave the case to nature. I cannot speak on this

point from personal experience, as I have never wounded the rectum; but it seems to me that some attempt should be made to obtain closure of the wound by the usual means, reserving the more severe resource of Mr. Liston in case of failure.

Perinæal fistula may also occur from imperfect closure of the wound. Like recto-vesical fistula, this is a very rare accident, and not likely to happen unless the parts about the neck of the bladder have been greatly contused or lacerated by violent efforts to extract the calculus. A catheter should be kept constantly in the bladder, and the sides of the wound touched every now and then with the nitrate of silver, in order to promote adhesive inflammation of the parts. Should these means fail, recourse must be had to the modes of treatment recommended for the cure of urinary fistula arising from other causes.

Retention of urine is the last accident to which I shall direct attention. It is not a frequent one, but when it does occur, it gives rise to great anxiety, and many other distressing symptoms which I have described in speaking of retention after lithotrity. Some obstruction to the flow of urine through the wound is the principal cause of the retention, and this is usually produced either by tumefaction of the wound, which has not been what we call a clean incision, or by blocking up of the part with clots of blood. In a few cases on record this latter cause of obstruction has been further increased by admixture of phosphatic deposits with the clots, which have not only blocked up the wound, but the whole canal of the urethra.

The use of Liston's tube will assist in preventing the

chance of any such obstruction. Should it take place to such a degree as to produce retention of urine, the patient must be relieved without delay. The most simple mode of removing a clot of blood is to pass the finger up into the bladder, or a gum elastic tube may be introduced through the wound, the urine drawn off, and the clots washed out by injections; opiates and warm fomentations will assist in relieving any pain or spasmodic irritation to which the retention of urine may have given rise.

As for the occurrence of impotence from the division of the seminal ducts, I believe it to be an imaginary accident, after the lateral operation at least. I have cut many children who are now grown up and the fathers of families. Should, however, such a misfortune occur, we possess no means of remedying it. After treatment here is of no avail.

CHAPTER XVIII.

PARALLEL BETWEEN LITHOTRITY AND LITHOTOMY.

I HAVE arrived at, perhaps, the most difficult portion of the task which I have undertaken, and that is, to draw a parallel between the two grand methods for the cure of vesical calculi. At an earlier period of lithotrity it would have been nearly impossible to institute a comparison between the two operations in an unbiassed manner. Lithotomy and lithotrity were then regarded as rivals, I might almost say, as enemies. The surgical world was divided into two companies, one supporting with all the authority of experience the pre-eminence of the old method, the other advocating with all the fervour of enthusiasm the adoption of a new, and, as they considered, superior operation. A parallel was drawn between the methods taken in the abstract. The questions debated were, "Is lithotomy superior to lithotrity?" or, "Should lithotrity altogether supersede the cutting operation?" This erroneous mode of examining the subject led to fruitless and almost interminable debates; after which, each party continued more rooted in its opinion than ever.

Nearly thirty years have passed away since the time to which I now allude. Reason and experience have dissipated the prejudices on both sides; and we are now, I believe, in a condition to examine this once thorny question in a cool and impartial manner. And here, at the commencement, I would observe that I do not propose comparing lithotomy and lithotrity in the abstract. I shall not attempt to determine whether lithotomy should exclude lithotrity, or *vice versâ;* whether the former be the general rule, and the latter only its exception. This would lead me into the errors I have just alluded to. Although the object of the two methods be the same, the means employed are extremely different, and the cases to which each method is specially applicable are also very different. Hence it would be illogical in the very highest degree, to institute any general or abstract parallel between the two operations. I shall pursue a different course, which I trust may bring us nearer to the truth. On some few points common to both, general remarks may be admissible ; for the rest, I shall compare, first, the operative proceedings; second, the obstacles peculiar to both methods; third, the accidents, primary and secondary, by which each may be followed; fourth, the cases to which each is applicable; and finally, the statistical results of both methods.

Lithotomy and lithotrity, as now performed, have been reduced to a wonderful degree of simplicity; and this, for many reasons, is a great advantage in any surgical operation. With respect to the operative proceedings in both methods, we may consider the means of arriving at the bladder, of seizing the calculus, and

of extracting it when seized. On nearly all these points, the advantage must be conceded to lithotrity. The steps preparatory to the latter operation are much more simple, and less calculated to produce any unfavourable impression on the patient's mind. He reclines on his own bed, with a pillow beneath the pelvis; there is no shaving of the perinæum—no binding of hand and foot together—no alarming preparations likely to shake his courage or diminish his hope. The injecting syringe and the lithotrite are the only instruments essentially necessary; and in ordinary cases, (those of which I now speak, for the others are reserved for obstacles, &c.)—in ordinary cases, I repeat, we arrive at the bladder with as much facility as if the case were one of the simple introduction of a catheter.

In lithotomy, the first step of making our way into the bladder is far from presenting the same degree of simplicity and ease. Indeed, as a celebrated surgeon remarked, some twenty years ago, the most striking difference between the two operations is, that the one arrives at the bladder through the natural passage, the other through a dangerous breach in the perinæum. In the former method the surgeon can hardly go wrong during this part of the operation ; and the only injury which he is liable to inflict is some abrasion of the mucous membrane, or some irritation of the neck of the bladder. In lithotomy, we have to penetrate deeply with the knife through a limited yet highly organised part of the body ; we have to feel for the groove of the staff at the bottom of the wound, introduce the point of the bistoury into the groove, pass the instrument into the bladder, and finally divide the prostate in a

peculiar way, neither too much, for fear of infiltration, nor too little, for fear of laceration. All these steps constitute a complex and delicate proceeding, which bears no comparison with the simple one of passing a blunt instrument through the urethra into the bladder. Upon this point, then, the advantage is manifestly on the side of lithotrity.

Having made his way into the bladder, the surgeon's next object is to seize the calculus between the forceps. Here, again, lithotrity presents some advantages over lithotomy. With the former method, the operator may proceed as slowly and deliberately as he pleases—the more deliberately the better: during the operation of lithotomy, the desire not keep his patient too long on the table often prevents the surgeon from proceeding with as much caution as he would otherwise be inclined to employ. The direction of the line through which the forceps is introduced by the perinæum is less favourable than the direction it takes through the urethra. In the former case, it passes from below upwards and forwards towards the roof of the bladder; in the latter case, it passes directly backwards to the posterior wall of this organ. It is infinitely more easy to rotate the beak of the lithotrite in the bladder than to turn down the blades of the forceps; and we know that the calculus usually lies on the floor of the bladder, behind or somewhat beneath the prostate. It is true that the surgeon often obtains great assistance by introducing his finger through the wound into the bladder, and this is an advantage on the side of lithotomy which must not be forgotten.

On the other hand, the lithotritist works his instru-

ment in an organ full of fluid, which gives him great facility for seizing the stone, without inflicting too much injury on the coats of the bladder; while the urine commonly escapes in a gush as soon as the knife has penetrated into the bladder. This organ contracts on the calculus at the moment the surgeon attempts to seize it with the forceps, and much difficulty is often experienced, even in simple cases, from this circumstance, which is inseparable from the cutting operation. There are many other points connected with this part of the operative proceeding; but, to avoid repetition, I shall examine them under the head of obstacles.

In the extraction of the stone, lithotomy is far superior to lithotrity; none but the most prejudiced would refuse to admit this. Through the passage made by the knife the calculus is extracted whole, and the patient is so far radically cured of his disease; while the lithotritist either does not extract the stone at all, leaving this part to nature, or extracts it by fragments. Hence the liability to relapse, or the danger of fragments becoming impacted in the urethra; from one of which accidents lithotomy is comparatively free, and from the other totally so.

We must, however, remember that this only applies to the extraction of small and moderate-sized calculi. For those above a certain size, it may fairly become a question whether the disadvantage of leaving the fragments in the bladder is not compensated by the danger of extracting a large stone through a wound in the prostate.

Finally, lithotrity is, properly speaking, made up of a number of successive operations; and although this

is not without some inconvenience, it presents the great advantage of enabling us to suspend or abandon the operation should any untoward accidents arise; whereas lithotomy, when once commenced, must be terminated at all risks. To leave a stone in the bladder is nearly as great a defeat to the surgeon, as to leave a woman undelivered would be to the accoucheur.

Having thus briefly alluded to the operative proceedings, let us take up the obstacles which may present themselves to the easy and successful performance of both operations. In simple cases—that is to say, when the calculus is of moderate size, the urinary organs are sound or only slightly deranged, and the general health good—the operation of lithotrity does not encounter any obstacle worthy of notice. Such a favourable state of things does not, however, always present itself. Various circumstances may occur to impede the different steps of the operation. Some of the obstacles thus created are common to lithotomy as well as to lithotrity. Any affection whereby the natural calibre of the urethra is diminished, whether this be from organic change or spasmodic contraction, will impede the introduction of the lithotrite or grooved-staff. An instrument of a certain size must pass through the urethra into the bladder; without this condition, lithotrity and the lateral operation are equally impracticable; but for various reasons, the obstacle of which I now speak is of less importance with respect to lithotomy than to lithotrity. Excessive sensibility of the urethra and neck of the bladder may also be present to such a degree as to render the introduction and working of the lithotrite excessively painful, in some cases even dangerous. This

condition of parts usually depends on some severe organic affection of the bladder; but it may be idiopathic, and if the operation be persevered in, severe rigors, nervous or febrile attacks, and other threatening symptoms, are apt to supervene. This and many other obstacles of an analogous kind are, however, to be considered as disadvantages of lithotrity, only so far as they limit the number of cases to which that operation can be beneficially applied. Lithotomy is little, if at all, affected by the condition of the urethra just alluded to. The grooved-staff remains for so short a time in the urethra, that its introduction or its sojourn in that part cannot be attended with any untoward consequences.

Excessive contractility of the bladder is an impediment of the kind just alluded to; it renders the case unfit for lithotrity; because to perform the operation safely, a certain space must exist between the surface of the stone and the walls of the bladder; this space is occupied by fluid, in order to remove the walls of bladder from the calculus, and enable the instrument to be worked without irritating the tissues in a dangerous manner. Now, when the bladder is very contractile, and this condition often exists in old cases of stone, it refuses to retain any of the fluid which is injected into it, and anything like a prolonged operation of crushing becomes highly dangerous.

The presence of fungoid or other tumours at the neck of the bladder is calculated to restrict the useful application of lithotrity in various ways. These tumours may render the introduction of the lithotrite altogether impossible, and, even when this does not

occur, they must oppose more or less obstacle to its free working in the bladder. The unavoidable friction of the instrument may also excite very severe pain, and in cases of fungoid tumour, give rise to hæmorrhage, either during the operation or a few hours after it. This latter accident is of a very serious nature, for the coagula of blood envelope the fragments of stone, and often render their escape from the bladder a matter of no small difficulty.

When describing the pathological effects of urinary calculi, I mentioned a peculiar one known under the name of the "bar-like ridge across the neck of the bladder." Whenever this transverse ridge is of any considerable size, it must of course render the introduction and proper working of the lithotritic instruments both difficult and painful. But it exercises a still more pernicious influence in impeding the free discharge of detritus from the bladder ; and this latter circumstance is aggravated by the fact, that in the cases now alluded to, the prostatic portion of the urethra is often dilated, and the fragments of the calculus are apt to become impacted in that portion of the canal. This is an accident of a very embarrassing kind ; for the operator finds it equally difficult to push the fragments back into the bladder, or extract them through the orifice of the urethra.

Enlargement of the prostate will naturally suggest itself as an obstacle that must often occur, more particularly in aged subjects, who are so liable to this affection. Experience, however, teaches us that unless the enlargement be very considerable, it does not create any insurmountable impediment to the application of

lithotrity. A moderate degree of tumefaction merely renders it necessary that we should be more cautious while introducing the instrument, and more careful to observe the effects produced during our attempts to crush the stone. Excessive enlargement of the gland, however, should, in my opinion, be regarded as a reason for rejecting lithotrity altogether ; but this point must be deferred until I come to a consideration of the cases to which the operations are respectively applicable.

In lithotrity all is not over when the curved instrument has been passed into the bladder. The more difficult part, that of seizing the calculus and reducing it into minute fragments, still remains. Various conditions of the bladder may impede the successful completion of the manipulations necessary to attain this object. These conditions have mainly reference to diminished capacity and increased sensibility of the bladder. Anything which diminishes the capacity of the bladder will impede the mechanical working of the lithotrite, or at least render it a dangerous matter to work the instrument freely ; while anything which increases the sensibility of the bladder will tend either to prevent us from completing the operation on account of the pain it may excite, or of the irritation and subsequent inflammation it may develope in organs which are probably in a state of disease.

A sacculated condition of the bladder is also a frequent effect of long-standing urinary calculus. The violent efforts which the patient so often makes to empty the bladder protrude the mucous coat through the bundles of hypertrophied muscular fibre. Cysts or sacs are thus produced ; the calculus may be originally

formed in one of these sacs, or it may become engaged in it as the calculus enlarges ; the neck of the sac gradually contracts round the foreign body, and when the latter is thus completely enveloped or "encysted," it is manifestly beyond the reach of lithotritic instruments. We cannot seize, much less crush it, without lacerating the mucous and muscular tissues of the bladder—without, in a word, inflicting fatal injury. In other cases, which bear some analogy to the one now described, the calculus, if it be small, may be entangled between the fibres of an hypertrophied bladder, or concealed behind some fold of the mucous membrane ; under either circumstance the operator would find more or less difficulty in grasping it between the blades of the lithotrite without pinching the coats of the bladder.

Many circumstances connected with the number, chemical nature, &c., of calculi may oppose material obstacles to their extraction, or render the operation both prolonged and difficult. Mere increase of number does not exercise any very unfavourable influence, provided the calculi be not at the same time extremely hard. Very large calculi cannot be seized between the blades of the instrument, and in such cases, therefore, lithotrity is out of the question. It is not, as I have remarked in a former chapter, easy to lay down the precise limits of the size of a stone which render lithotrity inapplicable. Our modern instruments will reduce to fragments any calculus which can be seized between the blades of the lithotrite ; and when the bladder is in a moderately healthy condition, a stone of nearly two inches in diameter can be fixed without much difficulty. When the calculus, though large, is at the same time friable, as

phosphatic calculi always are, the operation of crushing is effected with comparative ease. On the other hand, mulberry and other hard calculi, if large, would oppose great obstacles to the completion of the operation within a moderate period: as for small and hard calculi, the screw lithotrite now crushes them with facility.

The shape of the stone does not now present any obstacle to lithotrity, although it did so formerly. The curved lithotrite easily seizes flat calculi, and the embarrassment once occasioned by the form of the calculus has been got rid of by the improvements effected since the introduction of curved and crushing instruments.

Having thus described the several obstacles which may render the operative proceedings more or less difficult during an operation of lithotrity, we may pass the same review for lithotomy, and shall be then able to compare with greater benefit the two methods together, in reference to this division of the subject.

Strictures of the urethra, &c., will present more or less obstacle to the introduction of the grooved-staff; but this is an impediment common to both methods. There is one obstacle, however, to the introduction of the staff, which requires particular mention. I allude to cases in which a stone impacted in the neck of the bladder sends a prolongation into the prostatic portion of the urethra. Here the material obstacle is generally of such a nature as to render the introduction of a staff impossible, and the lateral operation cannot be had recourse to, except under the most unfavourable circumstances.

One of the main differences between the two methods, as I have already mentioned, is, that one penetrates

into the bladder through the natural passages, and the other through an artificial opening in the perinæum. For lithotrity we found that our first obstacles were seated in the urethra and neighbourhood of the bladder; for lithotomy we must seek them in the perinæum. This simple remark at once leads to the conclusion that the material obstacles to executing the first steps of lithotomy must be fewer, and of less importance, than those which oppose the application of lithotrity, because the perinæum is seldom the seat of pathological change, and is not subject to functional disorder, whereas the natural passages are often the seat of organic and functional disease.

Deformities of the pelvis and hip-joint may prevent us from placing the patient in the position suitable for the lateral operation. Tumours of the perinæum, irregularity in the form of the pelvic outlet, and a few other causes, which are so rare that they do not require mention, may render it impossible to penetrate the membranous portion of the urethra. But, as I have already remarked with respect to lithotrity, these and other obstacles of an analogous kind, are to be regarded as disadvantages only in so far as they limit the number of cases to which lithotomy may be applied. They are not defects in the operation itself, nor are they consequences of any defect, but circumstances of an extraneous and accidental nature, which limit the range of its applicability. Unusual depth of the perinæum, a condition which always accompanies obesity in a greater or less degree, renders the completion of the first incisions difficult, by increasing the distance between the external surface and the membranous portion of the

urethra. In such cases the operator is unable to make his way into the urethra with the desirable ease and rapidity; he is compelled to introduce his finger frequently into the bottom of the wound, and sometimes is unable to feel the groove of the staff in a distinct manner. This condition of the perinæum also often prevents the operator from making the necessary examination of the bladder with his finger, and is an obstacle, as we shall presently see, to the extraction of the stone. In young subjects, again, the bladder is apt to retreat before the finger or forceps; the distance of its cavity from the external surface is thus increased, and a similar effect produced, though from a different cause, as in cases of deep perinæum.

In the lateral operation the internal incision is made either by running the knife employed for the external incisions along the groove of the staff into the bladder, or by substituting a beaked knife for the scalpel, with which the membranous part of the urethra has been divided. In either case some little difficulty may be experienced. The sharp point of the ordinary knife cannot always be made to glide regularly along the groove of the curved staff; and to obviate this difficulty, Mr. Key, following the example of the older surgeons, proposed the use of a straight staff. On the other hand it is occasionally difficult, especially if the perinæum be deep, to find the part of the urethra which has been opened, and to introduce the blunt end of the bistoury into it. When the cutting instrument has been well fixed in the groove of the staff, the only material obstacle to completing the incision to the desired extent which can present itself, is induration of the prostate.

In some few cases this induration is of a scirrhous nature, and the tissues of the gland have been found so hard as to render it almost impossible to divide them with a knife. The lithotome caché, indeed, has more than once been broken in attemps to divide an indurated prostate.

Having made our way into the bladder, the next steps in the operation of lithotomy are to seize the stone and extract it. Here various difficulties may arise, some of which are essentially connected with the method, while others depend on the condition of the urinary organs or on the calculus itself. In some cases the best operators have been foiled for a considerable time in their efforts to seize the stone, although no impediment of any kind could be discovered. Depth of the perinæum is also an obstacle, as I have just observed ; but the principal one arises from the enlargement of the prostate. This morbid condition contributes to the difficulty in several ways. It increases the distance between the external wound and the cavity of the bladder ; it prevents the operator from employing his finger in an useful manner to explore the bladder or alter the position of the calculus if necessary ; it causes deviation of the urethral canal, and has a tendency to tilt up the forceps towards the roof of the bladder ; finally, any considerable enlargement of the middle lobe of the prostate increases the depression in the floor of the bladder, on which the calculus usually rests, and thus adds greatly to the difficulty of seizing it with the lithotomy forceps.

The same morbid conditions of the bladder which impede the operator in his attempts to seize the stone

with a lithotrite will also impede the action of the forceps; obstacles of this class are common to both methods, and I shall therefore merely enumerate them in reference to lithotomy. They are:—excessive irritability of the neck of the bladder; hypertrophy of its muscular coat; a contracted state of the bladder, especially if this be joined to great irritability, as is often the case; relaxation of the mucous membrane, with folds behind which the stone may lie concealed; a reticulated, columnar, or encysted state of the bladder; hour-glass contraction of the bladder, or irregular position of the calculus in that organ. Smallness and flatness of the stone are likewise circumstances which may render it difficult to seize the foreign body with the lithotomy forceps. When the calculus has been firmly seized between the blades of the instrument, it can generally be extracted without any great difficulty. Those which do arise are almost always connected with an immoderate size of the stone, but they will be considered under the head of accidents.

When a flat-shaped stone has been seized by one of its long diameters, there may be some difficulty in extracting it, and its position in the forceps must be changed. Should the bladder contain a great number of small calculi, the operation of removing them with the scoop is protracted, and there is some danger of our exciting inflammation of the bladder. A friable stone may give way under the pressure of the forceps, breaking up into numerous small fragments like mortar, and rendering the process of extraction extremely long. I have had a case of this kind under my care in which nearly a month elapsed before the whole of the frag-

ments were discharged through the wound in the perinæum.

Hypertrophy, with induration of the prostate, and a want of extensibility in the neck of the bladder, will present obstacles to the extraction of the calculus, because the parts just named do not dilate sufficiently to let the stone pass with ease through the wound. Laceration of the gland and neck of the bladder has sometimes been the result of this condition in old persons.

I have now explained as briefly as was consistent with clearness, the different obstacles which the surgeon may encounter in the performance of lithotomy and lithotrity. We are, therefore, prepared to compare them together, so far as obstacles are concerned, leaving their accidents and applications for another occasion.

Let us take up, in the first instance, the obstacles which may oppose our opening a passage into the bladder. In lithotrity this passage is already open through the urethra, and the only difficulties the operator can meet with—omitting stricture, &c.—are from spasmodic contraction of the urethra, morbid sensibility of the neck of the bladder, enlargement of the prostate, or tumours and other impediments at the neck of the bladder. In simple cases—and these constitute nearly three-fourths of the cases to which lithotrity is applicable—the obstacles now mentioned either do not exist, or are so slight as not to acquire much importance. There is no greater difficulty in introducing the lithotrite —that is to say, in making our way into the bladder —than in passing a full-sized catheter.

In lithotomy, whether the case be a simple one or not, the external and internal incisions are always of the

same character, requiring the same coolness, the same degree of anatomical knowledge, and the same practical experience, for their successful performance. In complicated cases the affair is different. For lithotomy, obstacles in the urethra or neck of the bladder can only impede the introduction of the sound ; for lithotrity, they impede the passage of the sole instrument with which the operation is performed. During lithotomy the grooved staff remains but a short time in the urethra, where it is held immovable ; it is therefore much less calculated to excite a morbidly irritable urethra or cervix, than the lithotrite, which is of larger size, more frequently introduced, and necessarily exercises more or less friction against the mucous surfaces. The staff will also pass more easily over any obstacle about the neck of the bladder than the lithotrite. Lastly, whenever this latter kind of obstacle is considerable, whenever the prostate is very much enlarged, when the neck of the bladder is much obstructed by any kind of swelling, lithotrity becomes inadmissible, not only from the impediments offered to its manual performance, but mainly from the serious accidents to which it may give rise.

In lithotomy we rarely find any circumstances which render very difficult the mere opening of a way into the bladder. Tumours in the perinæum, and deformities of the pelvis, are extremely rare, and need hardly be taken into account. Unusual depth of the perinæum, the occasional difficulty of hitting on the groove of the staff, and the obstacle opposed by a scirrhous condition of the prostate are not frequent, and are certainly of less importance than the impediments to lithotrity which I have just noticed ; they are never carried so

far as to compel us to abandon the operation. The dangers and disadvantages of lithotomy do not lie here; they do not depend on the material difficulties which the surgeon may experience in cutting his way into the bladder, but on the accidents to which the incisions may give rise ; indeed, in one point of view, the more freely and readily the opening is made, the more danger is there of subsequent accidents.

The obstacles to seizing the calculus in the bladder are precisely the same for both lithotrity and lithotomy, because this part of the operative proceeding is identical for both. We have therefore only to consider their comparative influence. Lithotrity here possesses many advantages. In the first place, by the mere act of having made his way into the bladder, the lithotritist has introduced the instrument with which he is afterwards to seize the stone. These two steps of the operation are completed at the same time and with the same instrument. In lithotomy it is the reverse. Having cut his way into the bladder, the lithotomist is compelled to dilate the wound with his finger, and then to pass the forceps along it into the bladder. However skilfully executed, this dilatation of the internal incision and passage of the forceps must sometimes irritate the prostatic portion of the urethra, and cases have occurred where the operator found it impossible to introduce the forceps at all, although the incisions had been carried to the usual extent. This impediment may present itself in aged persons from rigidity or spasmodic contraction of the neck of the bladder.

In the second place, the lithotritist works his instrument in a cavity filled with fluid ; and he can multiply

or prolong his endeavours to grasp the stone without any great danger. In lithotomy the urine generally escapes as soon as the bladder has been opened, the bladder contracts on the stone, and unless the operator succeed in seizing the calculus at this particular moment, he may find some difficulty in doing so afterwards, or may irritate the coats of the bladder, which become applied more or less closely round the blades of his forceps. Lastly, it requires little reflection to perceive that the direction in which the lithotrite is introduced, and the shape of that instrument, are circumstances much more favourable for seeking and seizing the calculus than the line of introduction, or the shape of the lithotomy forceps. In simple cases the stone seems to fall of its own accord, as it were, between the blades of the lithotrite; while, in simple cases also, the best lithotomists have spent nearly an hour in vain search after the calculus.

If we now examine particular obstacles, and inquire what are those which oppose the fixing of the calculus between the blades of the instrument in both methods of operating, we find that some depend on the condition of the urinary organs, and some on the nature, position, &c., of the stone. Under the former head we have great contractility and sensibility of the bladder, enlargement of the prostate, an hypertrophied or sacculated condition of the bladder; these obstacles are common for both, and, in addition, we have depth of the perinæum for lithotomy. With respect to the calculus itself, we have its size, position, and shape to take into consideration.

A contracted and irritable state of the bladder renders lithotrity dangerous, and thus greatly limits its sphere

of utility. But if these two conditions, when in excess, contra-indicate lithotrity, they are scarcely less unfavourable for lithotomy. When an irritable and highly sensitive bladder is closely applied over a large stone, the dangers and difficulties of extraction become increased tenfold; and although the operator may succeed, after painful and laborious efforts in removing the foreign body, experience tells us that death is too often the result—after the lateral operation at least.

A moderate enlargement of the prostate creates perhaps less difficulty in seizing the stone for lithotrity than for lithotomy, because, as I have already observed, the curved lithotrite is more easily rotated than the forceps, and made to explore the depression behind the gland with greater facility. Considerable enlargement of the prostate does not render lithotrity impossible, but it exercises such an influence on the result of the operation as to induce the prudent surgeon not to have recourse to crushing instruments.

This condition is also unfavourable for lithotomy, though in a less degree. It places the calculus beyond the reach of the finger, throws up the forceps above the floor of the bladder, and increases the distance between the cavity of that organ and the lips of the external wound to such an extent that the ordinary forceps have sometimes been found too short to penetrate beyond the neck of the bladder.

Those conditions of the bladder which I have described under the names of reticulated, columnar, and sacculated, present such serious obstacles to seizing the stone, that I would never think of employing lithotrity in such cases. They are almost equally unfavourable

for lithotomy; but here the latter method has this great advantage over the former, that the surgeon can often introduce his finger into the bladder, and either alter the irregular position of the stone, or so far disengage it from the columns or the sac as to permit of the forceps being applied on its surface. It is this introduction of the fore-finger which gives the advantage to lithotomy in all cases of obstacles to seizing the stone; but the advantage ceases whenever the obstacle is beyond the reach of the finger.

The shape of the stone presents no obstacle to the action of modern crushing instruments; flat stones, however, often elude the blades of the lithotrity forceps. The size of the calculus is of more importance, and for many reasons; now, however, I have only to speak of its influence with respect to seizing it. All surgeons are agreed, that calculi of very small size are not easily laid hold of with the lithotomy forceps, and many recommend us to have recourse to the scoop under this circumstance. Yet the prolonged exploration of the bladder in search of a small stone, is apt to irritate the mucous membranes, to say nothing of the fact that it is always an undesirable thing to prolong an operation of lithotomy, no matter what the cause may be. On the other hand, the small size of the stone presents little or no obstacle to the action of the lithotrite;—an instrument which seizes even minute fragments with comparative facility, cannot be found defective when applied to small calculi. The size of the stone is a most important element, and exercises very great influence on the result of both operations. A very large stone cannot be seized by the lithotrite; the lithotomy for-

ceps have a wider scope of action, but the great difficulties are during the extraction of the stone.

But it is not easy to draw a parallel between the two operations in this respect, because there is, properly speaking, no extraction of the stone in lithotrity. Here extraction is replaced by crushing, and discharge of the detritus; the latter being sometimes left to nature, and sometimes effected artificially. Any analogy which previously existed between the two methods has now totally disappeared. Still we can perceive at the first blush that there is a great advantage in being able by lithotomy to extract the foreign body, the *fons mali*, unbroken, and in a rapid manner. If the cutting operation be inferior to lithotrity in two of the steps, viz.—in making a passage into the bladder and in seizing the calculus, it is unquestionably superior in the third or final step, which consists in the removal of the foreign body from the bladder. This holds good at least for all calculi below a certain size. In such cases the obstacles to the extraction of the stone are commonly of small importance. A flat stone may have been seized unfavourably, and the operator is obliged to change its position in the forceps; or some fragments of a soft calculus may be broken off, and the accident prolongs the operation. For large calculi the case is far different; but the difficulties here depend not so much on the actual size of the foreign body, as on the fact that the surgeon thinks it imprudent to make a sufficient opening for its extraction. I shall defer this point until we come to accidents, where it may be considered more advantageously.

In lithotrity, extraction of the stone, if I may use the

term, is a more complicated business; for it is made up of two parts, viz., crushing, and discharge of the detritus. When the stone has been seized, the only obstacle which can prevent its being crushed is excessive density of the foreign body; but for many reasons great hardness of the calculus is an unfavourable circumstance in lithotrity, and will render the operation inadmissible, whenever the stone is at the same time large, or the urinary organs much disordered. On the other hand, friability of the calculus, which is an impediment to lithotomy, is a very favourable circumstance in lithotrity. Crushing of a stone in the bladder cannot be effected without danger, unless several conditions are present. The instrument must have room to work in the bladder, and therefore that organ must not be too contracted. The operation, generally speaking, must be repeated several times, and therefore the urinary organs must not be too sensitive or irritable. Enlargement of the prostate must not have proceeded to any considerable degree, and the neck of the bladder must be free from tumours or other material obstacles. All these circumstances tend to place the steps of the operation which we now consider, in an unfavourable light, as compared with extraction of the stone in lithotomy. Lastly, when the stone has been crushed, we have merely changed its physical condition, and reduced it into fragments. These latter must be discharged. In many cases this is easily effected; in many others the fragments become impacted in the neck of the bladder or in the urethra, giving rise to severe symptoms, or perhaps necessitating a second and different operation.

To sum up, then, what has been said, and draw a parallel between the two methods considered merely as operative proceedings, I would conclude that in two out of the three parts into which each operation may be divided, lithotrity is superior to lithotomy.

In the means of arriving at the bladder for ease, simplicity, and safety, the latter cannot bear a comparison with the former.

For seizing the stone, lithotrity affords greater facilities.

For the third step, which consists in its extraction, lithotomy is much superior to lithotrity.

These conclusions, I would again observe, merely apply to both methods considered as operations. They refer in no way to the different accidents which each operation may produce, or to their relative value as means of cure.

Hitherto I have examined the comparative advantages of lithotrity and lithotomy, considered merely as operations, and with regard to the obstacles which may impede their performance. The two methods may next be compared in the accidents to which they may give rise, and the cases to which they are respectively applicable. I shall not examine reputed accidents—that is to say, accidents which have no essential connexion with the mode of operating. Enough has been said upon this point ; and it is evident that laceration of the urethra, perforation of the bladder with the lithotrite, the forceps, or the lithotome caché, &c., are accidents which have occasionally occurred, but should not be laid to the account of the operation. Each method, however, is liable to be followed by certain effects of a more

or less dangerous nature. Let us commence with those peculiar to lithotrity.

They are mainly dependent on the working of instruments in a sensitive or diseased bladder, and on the irritation produced by the retention of detritus in the bladder, or the impaction of fragments in the urethra. Formerly, one of the points debated with great animation between the advocates of the respective systems was, whether lithotomy was not a more painful operation than lithotrity, and *vice versâ*. The use of chloroform has relieved us from this element of discussion. Patients can now be operated on without pain, and it is therefore unnecessary to examine which of the two methods is the least painful; but if chloroform were not employed, lithotrity, when applied in a proper manner, is a much less severe and painful operation than lithotomy. What I would call secondary pain may, however, supervene after either operation. In lithotrity this secondary pain is excited by the passage of the fragments along the urethra, or their impaction in that canal. In lithotomy the secondary pain is produced by morbid conditions of the wound, or the passage of urine over its raw surface. The two inconveniences pretty nearly balance each other; for if the pain of an impacted fragment be unquestionably greater than that produced by the passage of urine through the wound, the latter accident is constant, while the former one is not frequent.

Hæmorrhage, properly so called, occurs so rarely after lithotrity, that the operation may be said to be exempt from this accident. Some slight discharge of blood may take place during the operation, from abrasion of the mucous membrane, or after the operation, from in-

creased action of the bladder; but the quantity of blood lost is never of sufficient amount to endanger life. The only cases in which I could conceive copious hæmorrhage possible would be those complicated by the presence of fungoid tumours, &c., about the neck of the bladder; but to such cases I do not consider lithotrity applicable.

Retention of urine is another local accident of lithotrity. This may depend on mechanical or physiological causes. The evacuation of urine may be impeded by detritus or coagula blocking up the passages, by spasmodic contraction of the urethra and neck of the bladder, or by an atonic condition of this latter organ. Retention from atony is a very serious and insidious accident, which requires the utmost attention on the part of the surgeon, and if neglected, may rapidly compromise the life of the patient.

The general accidents of lithotrity may be comprised under rigors, febrile attacks, and nervous disturbance. Rigors and severe nervous symptoms are liable to occur when the operation of crushing has been imprudently prolonged or repeated at short intervals in patients whose urinary organs are in a very irritable state. Over distension of the neck of the bladder is probably the most frequent cause of the rigors, and the nervous disorders appear to be chiefly connected with morbid sensibility of the urinary passages. The irregular attacks of fever generally depend on this latter cause also, but a permanent febrile state may reasonably be attributed to incipient inflammation of the bladder or kidneys. In some very rare cases, even the first attempt at lithotrity has been followed by nervous accidents, similar to those

which characterise the shock after lithotomy. Baron Larrey mentions a case of this kind in the practice of M. Civiale, which terminated fatally on the third day.

Next to irritation, the most frequent of the ill effects which may follow lithotrity is inflammation of the mucous coat of the bladder. Some writers include peritonitis amongst the occasional accidents of the operation, but experience shows that it is very rare; in the few cases where this accident did occur, it depended on some severe injury inflicted on the bladder during the use of the lithotritic instruments, and it may fairly be set down rather to the account of the operator than of the method.

Phlebitis, with its usual consequence, purulent infection of the blood, is another of the rare accidents depending on lithotrity. M. Leroy d'Etiolles relates a case in which the veins of the penis became inflamed from the impaction of a fragment of stone in the urethra. The veins contained pus, and the patient fell a victim to purulent infection. The "Ephemerides" of Montpellier, for March, 1828, contain another case of purulent infection after lithotrity, but here the urethra had been lacerated during the operation. Lastly, I have had the misfortune to lose a patient myself from the same accident, developed, I have no doubt, in consequence of the bladder having contained a cyst filled with purulent matter.

Inflammation of the bladder, whether acute or chronic, is an accident of lithotrity, and it would require no small degree of prejudice to deny that such an occurrence is not to be apprehended in unfavourable cases. I have already explained the morbid condition of the

bladder often produced by the long-continued presence of a calculus in that organ; we have seen it contracted and irritable, endowed with morbid sensibility, often in a state of chronic inflammation, or extremely disposed to take on that peculiar inflammation which is accompanied by a tendency to throw down phosphatic deposits. In these and many other cases, the prolonged working of lithotritic instruments in the bladder, must excite more or less irritation, and, unless the surgeon proceed with the utmost caution, may produce acute cystitis of a dangerous character.

Finally, to complete this brief notice of the accidents of lithotrity, I may mention relapse, retention of detritus in the bladder, or impaction of fragments in the canal of the urethra.

The accidents of lithotomy are of a very different nature from those just enumerated. They are for the most part connected with the *incisions*, whereas those of lithotrity almost exclusively depend on the irritation caused by the friction of a blunt instrument against the coats of the bladder. It has been usual to divide these accidents into primary and secondary, or into those which occur during the operation, and those which appear at a certain period after its completion.

When we reflect on the anatomy of the perinæum, and the number of important parts which are there crowded together in a narrow space, we must confess, that making our way into the bladder by the lateral operation cannot always be exempt from danger. Hæmorrhage is the principal one, and to this accident the lateral method exposes us more than any other. Some of the perinæal arteries lie immediately beneath the

knife, and can hardly be avoided; in other cases the accident is the result of varieties in the arterial system, which no operator can foresee, and sometimes the division of an arterial branch is caused by an endeavour to avoid some other accident. Thus the artery of the bulb runs great risk of being divided, if the surgeon commence his external incision too high, while the hæmorrhoidal branches, and even the internal pudic itself, may be wounded, if the incision be carried too low, and made to fall too close on the ramus of the ischium.

Venous hæmorrhage, again, may arise either from division of the bulb, which in aged patients is large and overlaps the membranous portion of the urethra, or it may come from the venous plexuses in the neighbourhood of the prostate. In this latter case the bleeding is often very abundant, while, from the depth and disposition of the parts, the surgeon is not always able to command it.

The rectum has sometimes been wounded—and that by the best operators—during the lateral operation. In some cases which I have already noticed, the intestine is developed to such a degree that it nearly surrounds the prostate, and must inevitably be wounded. At other times the accident may be chiefly attributed to the operator, who has commenced his external incision too low, or has raised the handle of his knife too much, while cutting into the bladder, along the groove of the staff. Injury to the vesiculæ seminales and spermatic ducts is, I believe, of such rare occurrence that it need not be taken into account.

The secondary accidents of lithotomy are more

numerous and of a far more dangerous character than the primary. Of the most formidable amongst them we are now relieved by the discovery of chloroform. The shock to the nervous system under which patients sometimes sunk within a few hours after the operation, and in the most unexpected manner, is now rarely if ever witnessed, and the influence of lithotomy on the moral condition of the patient is no longer to be apprehended. Still, though severe and immediately dangerous symptoms of a nervous kind are avoided by the use of chloroform, the patient occasionally remains in a state of prostration which is unfavourable to the healing of the wound or to his subsequent recovery.

Secondary hæmorrhage is more frequent than primary, and of a more dangerous character. It usually sets in from the fifth to the eighth day after the operation ; sometimes sooner. No patient can be said to be free from danger of this accident, because, however carefully the operation may have been performed, the clot which blocks up the mouth of a divided vessel may be separated by softening, and troublesome bleeding be the effect. When the hæmorrhage sets in towards the close of the first week, the state of the wound renders it both difficult and useless to apply a ligature, and the accident is further aggravated by the circumstance that it usually occurs during the absence of the surgeon. An instructive case of this kind is related in a late number of the "Provincial Medical and Surgical Journal," (Sept. 15, 1852.) The operation was performed with ease, and considered very successful. For four days the patient appeared to be doing extremely well, but secondary hæmorrhage set in on the night of

the fourth day. The accident was neglected by the nurse, and the patient sunk on the fifth day. On examining the body after death, the source of the bleeding was traced to the superficial perinæal artery which was larger than usual, proceeded across the perinæum towards the median line, and lay directly in the way of the incision.

Phlebitis and purulent infection are said to be not unfrequent accidents after lithotomy, but they have not been often observed in this country or in America. Numerous examples, however, have occurred on the continent; M. Blandin met with six cases in a short period of time, and many other French surgeons describe them as amongst the occasional causes of death after lithotomy. The peculiar arrangement of the prostatic veins, which are enclosed in fibrous sheaths, and thus prevented from retracting, may perhaps account for their tendency to inflame after lithotomy; but I cannot avoid suspecting that some prevailing disposition, or perhaps too free incision of the prostate with the lithotome caché, may have favoured the development of the disease in the cases alluded to by M. Blandin.

Retention of urine, from some accidental impediment to its discharge through the wound, sometimes occurs after lithotomy; and patients are occasionally subject to the serious inconveniences arising from urinary fistulæ.

Inflammation of the bladder and prostate must be enumerated amongst the secondary accidents of lithotomy. They are not of frequent occurrence, nor do they arise, as one might at first sight be inclined to think, from the mere fact of a wound having been inflicted on

these parts. These accidents are produced in the same way as in lithotrity, by the action of the forceps during protracted efforts to seize and extract a large stone. When we reflect that these efforts are sometimes continued for an hour at a time, we can understand how they may excite more severe irritation than attempts at crushing, which should never go beyond eight or ten minutes, and are repeated at intervals of several days.

But the accidents and dangers of which I have now spoken are almost as nothing when compared to those arising from the difficulty of proportioning the internal incision to the size of the foreign body which we desire to extract through it. This is the great defect of the lateral operation, and on it depends, in a great degree, the accidents which prove fatal to a majority of those who die after lithotomy. I entered so fully upon this part of the subject when speaking of the obstacles which the operator has to encounter in the extraction of large calculi, that I shall merely now refer to some of the principal points. The internal incision of the lateral operation is made through the prostate, and sometimes even through the neck of the bladder. From the mere incision of the prostate no danger is to be apprehended; but the great difficulty is to make it in such a manner that the stone may be extracted without much effort, and the incision itself shall not be carried beyond the limits of the gland. In the one case, we have infiltration of urine into the cellular tissue of the pelvis; in the other case, we have over distension, contusion, or laceration of the parts about the neck of the bladder, followed by unhealthy inflammation and sloughing abscesses of the most dangerous character. From the

lax nature of the cellular tissue immediately underneath the peritonæum, the urine infiltrated above the superior pelvic fascia easily gains the upper part of the pelvis; and if the patient survive for a few days, peritonitis almost certainly supervenes, from the irritation of the fluid beneath the serous membrane. In other cases, the infiltration takes place into the cellular tissue between the prostate and rectum. This accident usually depends on the external incisions not having been made sufficiently free and in the same direction as the internal one. It is not so dangerous as infiltration into the subperitonæal cellular tissue, but it is always a serious complication, and protracts the convalescence, if it may not occasion death.

Relapse of the calculous affection may occur after lithotomy as well as lithotrity; patients have been cut as many as four times. This accident depends either on the fact that some small calculus has been left behind in the bladder, or from the breaking of a friable or rough stone during extraction. When a second calculus has been formed in consequence of the original tendency to throw down urinary deposits, the occurrence cannot be attributed to lithotomy.

Let us now draw a parallel between the two methods with respect to the accidents which each may give rise to; and as these accidents are the cause of death, this part of our subject will include a comparison of the causes of death after lithotrity and lithotomy. What are the accidents of lithotrity—those which can be really connected with the operation? They are nervous and febrile disorders; retention of urine; arrest of fragments in the bladder or urethra; hæmorrhage;

purulent infection; relapse of the complaint; irritation and inflammation of the genito-urinary organs.

What are the accidents of lithotomy? Nervous accidents; primary and secondary hæmorrhage; wound of the rectum; phlebitis; fistulæ; retention of urine; relapse; inflammation of the genito-urinary organs; infiltration of urine into the pelvic fasciæ; abscess from injury to the prostate and neck of the bladder.

Before passing in comparative review these several accidents, it may be well to say a few words on the condition of the patient in ordinary cases after each operation. Here everything presents itself to the advantage of lithotrity. This depends partly on the nature of the operation, and partly on the circumstance that it is performed at successive intervals, between which any irritation produced has time to subside. I have no desire to exaggerate the benefits of lithotrity, but those who have witnessed its application to a number of simple cases, must have seen that no other important surgical operation is attended with so little general or local disturbance. In many cases the patient is never confined to bed for a single hour, and is often able, after a few days, to attend to his ordinary business as if nothing had occurred.

After lithotomy, even in the most simple and favourable cases, how different is the matter! A wound has been made into an important organ, through a narrow and complex space, with the rectum behind, arteries on the sides, the prostate above, and still higher up the peritonæum. The patient must be confined to bed for weeks in one incommodious posture, and under rigorous regimen. During the first eight or ten days we are in

constant anxiety about him—ever examining the wound for fear of hæmorrhage—ever examining his general condition for signs of inflammatory accidents ; and this with the painful feeling, that if such accidents do manifest themselves, the patient's fate is very often sealed.

As for the accidents themselves, and their probable consequences, those connected with lithotrity are fewer in number and of a much less serious character than those which depend on lithotomy. As I have more than once remarked, one of the main advantages of lithotrity is, that it gets rid of the wound, while the necessary infliction of this is the capital disadvantage of lithotomy. Still the division of the soft parts may be said to be accompanied by some benefit ; for the loss of blood which always ensues in a greater or less degree, tends to diminish inflammatory congestion of the bladder, and often, if not too great, has a very beneficial influence on the chronic cystitis which so often accompanies vesical calculus. It is unnecessary to compare the pain respectively produced by both operations, for this can be avoided by the use of chloroform.

Nervous disturbance, rigors, &c., occur more frequently after lithotrity than after lithotomy, and so do irregular attacks of fever. On the other hand, it must be observed that these accidents are seldom of a severe kind after lithotrity, provided the case has been suitably selected. By preliminary examination, the surgeon can generally ascertain how far the bladder may be morbidly sensitive, or how far it is likely to bear the necessary manipulations ; he can suspend the operation if any severe nervous symptoms or rigors appear ; he may even abandon it altogether

without any serious inconvenience. The nervous accidents of lithotomy, if less frequent, are much more dangerous than those of lithotrity, the operator has little means of judging how far they are likely to occur, and none of avoiding them, for he cannot suspend or even abandon his operation. Lastly, the febrile attacks after lithotrity are often of an intermitting kind, and dependent on irritation, while those of lithotomy, are more frequently continued, and symptomatic of inflammation.

The retention of urine which occasionally supervenes after both operations arises from very different causes, and it is not easy to fix its relative importance in a definite manner. Retention, as we have seen, may follow lithotrity, from an atonic state of the bladder, especially if this be accompanied by enlargement of the prostate, and obstruction of the urethra by detritus. After lithotomy, this accident may be occasioned by tumefaction of the wound, or by the presence of coagulated blood in the bladder or urethra. The causes of the accident in the former case are much more serious than in the latter, and of more frequent occurrence, but they admit of a more simple remedy; for the use of injections and of the catheter cannot be compared with the inconvenience of keeping a tube permanently in the wound, or endeavouring to remove any obstacle through parts which the operation has rendered irritable and prone to inflame.

As for the comparative frequency and danger of hæmorrhage after the two operations, little need be said; these are points upon which no difference of opinion can possibly arise. In ordinary cases, the loss of blood

occasioned by the use of lithotritic instruments is merely an exudation from the mucous membrane, of an insignificant kind. In other cases the discharge of blood—I cannot call it hæmorrhage—is caused by the strong contractions of a distended bladder. The bleeding from either cause is easily mastered, and the only inconvenience to which the latter form can give rise, is that of leaving clots in the bladder, which envelope the fragments and impede their free evacuation. In short, nothing which deserves the name of hæmorrhage can take place after lithotrity, unless the urinary organs have been lacerated, or unless the operation has been performed in cases not suited to it—those, for example, in which the neck of the bladder is obstructed by fungoid or other tumours, &c.

There is some difference of opinion amongst surgeons as to the frequency of hæmorrhage after lithotomy; none relative to the danger of such an accident, whether it be primary or secondary. In England, surgeons are inclined to consider this accident as comparatively rare. Mr. Liston assures us that he met with only one serious case in nearly a hundred operations; but others have not been so fortunate, and the examples published from time to time in the journals prove that neither skill nor care is sufficient to guarantee the patient against its occurrence. In France, hæmorrhage is certainly a more frequent accident than with us, for M. Begin and Dupuytren, who have examined this point with a great deal of attention, conclude that one-fourth of those who die after being cut for stone perish from hæmorrhage. Taking the general mortality of lithotomy to be one in five, this would give us a proportion

of one death from hæmorrhage after every twenty cases operated on. The danger of the accident need not be insisted on. Superficial arteries can be easily secured during the operation; the deeper-seated vessels are taken up with great difficulty. Secondary hæmorrhage, again, is often a source of great danger, for it is not easy to determine the precise seat of the hæmorrhage; the condition of the vessels often contra-indicates ligature of their orifices, even if they could be found; while plugging the wound, the only resource which is left, often causes a great deal of irritation, and is of comparatively little benefit in those dangerous cases of secondary bleeding which depend on division of the venous plexus about the neck of the bladder and prostate.

Relapse of the calculous affection is an accident common to lithotrity and lithotomy. Having already described the causes of this accident, and the circumstances under which it is liable to occur, I shall now merely observe that it seems to follow lithotrity more frequently than lithotomy in the proportion of six to one; such at least is the deduction which I draw from the statistics I brought forward in a former chapter. On the other hand, relapse after lithotomy is a much more serious affair than the same accident after lithotrity—that is to say, if we presume that the mode of operating in the case of relapse is not altered. The phosphatic deposits and retained fragments, which constitute calculi of secondary formation after lithotrity, can be crushed without any difficulty or danger. A case of relapse after lithotomy exposes the patient to all the dangers inseparable from the cutting part of the operation.

The fatal disease known under the name of purulent infection is another accident common to the two methods. It is not noticed amongst the causes of death after lithotrity by M. Civiale, in the parallel which he published in 1836; but in the second edition of his work on "Diseases of the Genito-Urinary Organs," he relates a case which occurred at the Hospital Necker in 1839. In the following year he lost another patient, also at the same hospital, from purulent infection during the preliminary treatment with bougies, and before any attempt at lithotrity had been made. In the year 1839, M. Amussat lost a patient from the same accident, and here also it was developed from the simple use of the sound employed to determine the presence of stone in the bladder. In 1828, M. Delpech, I think, had a case in which lithotrity was followed by abscesses in the liver and knee-joint; and not longago, a similar accident occurred to myself in St. Mary's Hospital. There is then, no doubt but that lithotrity may give rise to the fatal complication of which I now speak, and it seems to me that its occurrence is very intimately connected with a pre-existing purulent affection of the bladder or urinary passages. It may also depend on phlebitis; but this latter, I believe, is extremely rare after lithotrity.

Purulent affection after lithotomy has been frequently observed in other countries, if not in this. Its connexion with phlebitis may account for the frequency of the accident; and I am disposed to think that it would be oftener noticed here if we were more familiar with the phenomena which constitute purulent infection of the blood. However this may be, the number of cases on record shows that the accident is of

much more frequent occurrence after lithotomy than after lithotrity; it is equally fatal after both methods.

Lithotrity, as well as lithotomy, has its peculiar accidents, of which retention of detritus and impaction of fragments in the urinary canal are very important. Impaction of a fragment is perhaps the most frequent accident to which patients who have been lithotrised are liable, and it is often of a serious nature when the bladder is very irritable. It may occasion retention of urine from the mechanical obstacle, or so increase the morbid irritability of the bladder and urinary passages, that any attempt to re-introduce instruments is followed by great constitutional irritation. Lithotomy is free from any danger of this kind. The only analogous accident which we can compare with it, is the incrustation of the sides of the wound with phosphatic deposits.

Irritation and inflammation of the bladder are the most serious accidents peculiar to lithotrity; and it may be fairly affirmed that its danger as an operation should be measured by its tendency to excite an inflammatory condition of the genito-urinary apparatus. It cannot be denied that the irritation caused by working lithotritic instruments in a disordered bladder may so exasperate the calculous disease as to place the patient in a very dangerous position, or develope latent disease in the kidneys and other parts of the body. From the same cause chronic inflammation of the bladder may be converted into an acute form, or the irritation produced by numerous operations may leave behind it chronic cystitis of a very troublesome and obstinate nature. On the other hand, it seems equally established, that none of these accidents are to be apprehended, in a dangerous

degree at least, when the case is of a simple kind, and when proper precautions have been taken to avoid the well-known causes of irritation. They only occur in those unfavourable cases where the urinary organs are considerably diseased, or in doubtful cases, when the operator is induced to give his patient the benefit of the doubt, and prefers the less formidable process of crushing to the risk of lithotomy. I cannot admit that this latter operation is, *cæteris paribus*, as likely to excite inflammation or irritation of the bladder as lithotrity. The difficulties experienced during the extraction of large calculi, and the frequent introduction of the forceps into a contracted bladder, may, undoubtedly, develop cystitis; but the dangers of lithotomy do not lie here: they depend on other circumstances, to which I shall presently direct attention.

Impaction of fragments in the urethra was mentioned as an accident peculiar to lithotrity. There are several peculiar to lithotomy. The rectum may be wounded; and although this accident is not dangerous in itself, it may give rise to very great inconvenience. Urinary fistulæ must also be enumerated; they never occur after lithotrity. The same remark applies to division of the seminal ducts or tubes; this accident, as I remarked in another part, is very rare during lithotomy. I merely mention it *pro formâ;* for lithotrity, the analogous accident is inflammation of the spermatic cord and testicles.

Intra-vesical inflammation is the special danger of lithotrity; *extra*-vesical inflammation is the great and special danger of lithotomy. In the former it is not always easy to separate the effects of the operation

from the effects of the calculus, and say how far the inflammation of the bladder which supervenes may depend on one or the other. In many cases it is merely an aggravation of some original disease of the mucous tissue. In lithotomy the inflammatory accidents which follow the operation and are produced by it, are the cause of death in nearly two-thirds of the fatal cases. Inflammation of the cellular tissue, and other parts about the neck of the bladder, is the main danger to be apprehended; all, or nearly all surgeons are now agreed upon this point.

A free incision of the prostate exposes the patient to the danger of infiltration of urine into the cellular tissue of the pelvis. This accident is quickly followed by inflammation of the worst kind; the urine makes its way beneath the peritonæum, the serous membrane becomes implicated, and if the patient happen to survive the first shock, he rarely, if ever, does the effects of peritonitis. In fifteen cases of death after the lateral operation which M. Blandin had occasion to examine, peritonitis was found nine times.

Contusion and laceration of the neck of the bladder during the extraction of a large calculus, and the efforts made to extract the foreign body from an irritable, contracted, or diseased bladder, not only produce great suffering, but give rise to secondary inflammation of the tissues surrounding the neck of the bladder, which is nearly as dangerous as that arising from infiltration of urine.

I shall not now recur to the difficulties that attend the extraction of large calculi, nor to the difficulty of always proportioning our internal incision to the size of

the foreign body which is to be removed. These points have been sufficiently discussed already, but I cannot avoid adding, that the secondary inflammation spoken of cannot always be connected with the extraction of large calculi, because this effect, as statistics show, is comparatively frequent; while calculi exceeding a few ounces in weight are comparatively rare.

The repeated shocks of lithotrity, or the more sudden and violent one of lithotomy, may develope latent disease of the kidneys, and thus prove fatal. As the secondary effect is equally dangerous in both cases, we have merely to consider its relative frequency. Upon this point I do not find sufficient data to enable me to form a decided opinion. M. Civiale and a few other writers affirm that lithotrity is much less liable to cause or aggravate renal affections than lithotomy; while other surgeons hold a contrary opinion.

We have next to compare the two methods with regard to the cases to which they are respectively applicable. This is a very important part of the subject. To form a correct notion of the value of lithotrity, it must be judged from the results it affords in cases to which experience shows the method may be properly applied. In nearly all such cases it is a safe and efficacious mode of treatment; in proportion as we recede from these cases, it becomes difficult of execution, and more or less dangerous in its application; and if we are imprudent enough to employ it in cases beyond its domain, it becomes even more dangerous than lithotomy itself. The object then, of the present comparison will be to restrict the two methods within their proper limits.

From the considerable space which I have devoted to indications and contra-indications, this part of the subject may be disposed of in a cursory manner. In determining the propriety of applying lithotrity to any case, two main points are to be considered—viz., the nature of the calculus, and the condition of the urinary organs. It is also necessary to reflect how far these two elements may influence the results of the operation, and enable the surgeon to complete it without exciting any dangerous irritation of the genito-urinary organs, or producing any unfavourable influence on the general health of the patient.

The presence of a great number of calculi in the bladder is unfavourable for lithotrity—less so for lithotomy. When the stone is very hard, and at the same time large, lithotrity is not applicable to the case. Still much will here depend on the condition of the bladder. If this organ be capacious, and not very irritable, the modern instruments will safely crush calculi of almost any density, provided they can be embraced between the blades of the lithotrite. Very large calculi do not admit of being so seized, and lithotrity is therefore not suited for their removal; but the lateral operation is almost inapplicable to cases of this kind, for hardly one patient in ten escapes the dangers attendant on the extraction of a very large stone through the neck of the bladder.

The position of the calculus has great influence on the facility with which it can be seized and crushed, and must therefore be taken into account. When it lies in an artificial cyst, lithotrity is out of the question, and lithotomy—at least the lateral operation—does not hold

out much greater prospect of success. The balance, however, is in favour of lithotomy. If the stone be embraced in a deep excavation behind the prostate, forming what I have termed hour-glass contraction of the bladder, both operations are contra-indicated.

Any serious organic disease of the bladder renders lithotrity inapplicable, and thus limits the sphere of its utility. Any great obstacle at the neck of the bladder will have the same effect. Hence considerable enlargement of the prostate, fungoid or other tumours about the neck of the bladder, the bar-like ridge, &c.,—all these circumstances would cause us to give a preference to lithotomy.

Chronic catarrh of the bladder does not contra-indicate lithotrity, other circumstances being favourable; but anything approaching acute inflammation should prevent us from having recourse to a method so likely to aggravate the complication.

An hypertrophied, irritable, and contracted state of the bladder contra-indicates lithotrity, and the same may be said of great sensibility of the neck of the bladder, unless the stone be small and rather soft, affording the hope that it may be crushed in a small number of sittings.

Atony, or partial paralysis of the bladder, is a circumstance unfavourable for lithotrity, though it does not absolutely contra-indicate it; but on this point I must refer to what I have said in another part of this work. Finally, for reasons which I also explained in the same place, I would transfer to the lithotomist all cases of stone occurring in persons under twenty-one years of age.

I have now laid down, I trust, all that is necessary for forming a judgment on the relative merits and demerits of the two methods. It has been said that lithotomy is applicable to all cases of urinary calculus, whereas lithotrity is applicable to a limited number of cases only; and M. Velpeau, M. Sanson, and other French surgeons, who took part in the celebrated discussion at the Academy of Medicine in 1835, insisted much on the great advantage which lithotomy presents in this respect. It is true that the cutting operation may be applied to nearly all cases of stone, without distinction, but this is not the proper way of putting the question. The real question is, Should lithotomy be so applied? and I have little hesitation in answering, No; for this simple reason, that in all cases of small calculi, unattended by any serious disease of the urinary organs, and when the patient's general health is good, the safety and advantages of lithotrity are so superior to those of lithotomy, that the latter operation should not, though it may, be undertaken to the exclusion of the former. I would therefore, in general terms, conclude that all calculous patients under the age of twenty-one, should be cut; and that all adults, except those unfit for the operation, should be submitted to lithotrity. The statistical results, which I have arranged in tabular forms, will bear out this general conclusion.

CHAPTER XIX.

THE STATISTICS OF LITHOTOMY AND LITHOTRITY.

In the parallel which I have drawn, lithotomy and lithotrity have been compared in a general manner; but this is not sufficient to determine the intrinsic value of each operation considered as a means of cure. I have still to examine their results, when applied in practice —the only true test by which they can be estimated.

It has been said that little reliance can be placed on statistical deductions from a number of operations performed by different surgeons, in countries far distant from each other, under a great variety of circumstances and influences, which prevent any one series of cases from possessing the same value as another series of equal number. This remark has a certain degree of weight, but it is no valid reason for rejecting statistics altogether; it only shows that they are not entirely faultless; and what branch of medicine—I might almost add, of human knowledge—is free from this reproach?

Our statistics are not perfect, because no two cases, and therefore no two series of cases, are perfectly identical in every respect, as are two lines or two angles. We cannot arrive at mathematical certainty; but when all

the essential points of any given number of cases have been properly ascertained, the value of disturbing influences can be estimated, the elements of resemblance or analogy can be fixed, and from these a great number of useful deductions can be drawn, just as the probable duration of human life in any given case can be fixed from deductions made from a consideration of numerous cases which are anything but identical.

I will not now dwell on the several conditions necessary for forming a good statistical *résumé*, and shall merely observe that one of the most essential is what has been called "the law of numbers." The greater the number the cases on which we operate, the less likely are our deductions to be weakened by various sources of error, to which conclusions from limited numbers are exposed. This remark applies in particular to lithotomy. While explaining the accidents of that operation, I showed how many of them depend on influences beyond the control of the operator, and were developed under circumstances for which it is difficult or even impossible to account. Hence great success may appear to attend the operation, when applied to a limited number of cases; but let the number be increased to any extent, and the causes alluded to come into play.

Every surgeon in extensive practice is familiar with this fact. Ten, twenty, thirty cases may succeed without interruption, and the operator flatters himself that he is never to lose a patient, when two or three deaths follow in quick succession, and reduce him to a level with his neighbours; or at least within the limits of variation which the analysis of a large number of cases indicates.

The examples mentioned by Mr. Liston and Mr. Crosse will illustrate this point. Mr. Liston states that all the patients submitted to lithotomy in University College Hospital for a period of six successive years—and they were 24 in number—from two to eighty years of age, recovered. Mr. Crosse records that 38 patients successively operated on in the Norwich Hospital (previous to November, 1834), by Mr. Dalrymple, Mr. Norgate, and himself, recovered.

These are splendid results, highly creditable to English surgery ; but it is manifest that from so limited a number of cases no correct estimate can be formed of the general mortality of lithotomy.

The only mode of arriving at a proximate result is to collect as great a number of properly authenticated cases as possible, and this I have endeavoured to do in the opposite table.

That table gives us a sum-total of 6,369 operations, more than two-thirds of which have been performed since the commencement of the present century. The number of deaths was 958, and the general mortality is therefore 1 in 6·62 cases.

The returns from the Luneville Hospital have been published by M. Castara ; those from Moscow by Dr. Roos, of St. Petersburgh; those marked with an asterisk by M. Civiale, in his work on Calculous Diseases. The sources from which I have derived the other returns are familiar to most surgeons.

The cases, I need hardly say, have not been selected, but all those which presented a sufficient degree of authenticity were admitted without other distinction.

The mortality in the English cases, 1,743 in number,

GENERAL MORTALITY AFTER LITHOTOMY.

Locality.	No. of Operations.	Males.	Females.	Deaths.	Proportion of deaths to cases.
Luneville Hospital ...	1492	1433	59	141	1 in $10\frac{67}{120}$
*Hotel Dieu, 1808 to 1830...	100	95	5	28	1 — $3\frac{68}{120}$
*La Charité, 1806 to 1831	70	...	...	35	1 — 2
*Beaujon, *La Pitié, *Maison de Santé ...	56	53	3	18	1 — $3\frac{14}{120}$
*Ten Departments of France	110	...	...	24	1 — $4\frac{69}{120}$
Private patients in Paris In 10 years:—					
Dupuytren's table ...	356	...	...	61	1 — $5\frac{101}{120}$
*Austria	133	...	...	25	1 — $5\frac{13}{120}$
*Bavaria	136	...	...	28	1 — $4\frac{17}{120}$
*Lombardy...	1044	...	...	217	1 — $4\frac{99}{120}$
Naples...	308	298	10	47	1 — $6\frac{67}{120}$
*Wurtemberg	120	120	...	7	1 — $17\frac{17}{120}$
*Bohemia	36	...	...	4	1 — 9
*Dalmatia	40	...	...	4	1 — 10
*Roman States	33	...	...	3	1 — 11
*Sardinia	21	...	...	6	1 — $3\frac{60}{120}$
*Sweden	36	...	...	5	1 — $7\frac{50}{120}$
*Denmark	35	...	...	12	1 — $2\frac{110}{120}$
*Cork Infirmary... ...	15	...	...	...	
St. Thomas's Hospital	144	...	...	15	1 — $9\frac{72}{120}$
Bristol Infirmary ...	354	347	7	79	1 — $4\frac{67}{120}$
Leed's Infirmary ...	197	...	...	28	1 — $7\frac{5}{140}$
Norwich Infirmary ...	704	669	35	93	1 — $7\frac{105}{140}$
St. Mary's, Moscow ...	411	...	...	42	1 — $9\frac{93}{140}$
Pennsylvania Hospital	83	...	...	10	1 — $8\frac{36}{140}$
Dupuytren's Bilateral Operation	42	38	4	9	1 — $4\frac{80}{140}$
Cheselden	213	...	...	20	1 — $10\frac{73}{140}$
Liston	115	...	...	16	1 — $7\frac{92}{120}$
Total	6369	...	...	958	1 — $6\frac{76}{120}$

is nearly 1 in 7; the 251 deaths give a proportion of 1 death in 6·93 cases, which is a very favourable result.

M. Civiale's work on Calculous Diseases† contains a

* The returns from localities marked (*) have been taken from M. Civiale's Tables.

† Traité de l'Affection Calculeuse. Paris, 1838.

great number of valuable tables, in the collection of which the author was assisted by returns forwarded to him from the principal hospitals of Europe. The first table (page 550) contains a summary of 3,991 operations of lithotomy ; but it is impossible to make it available for my present object, because the results of lithotrity are mixed up with those of lithotomy.

Another table (page 582) contains a summary of 2,368 operations performed in France since 1738 ; the number of deaths is 374. It is necessary, however, to deduct the cases of lithotrity, and correct an error, M. Civiale having set down the deaths at Luneville as 150, whereas they were only 141.

With these corrections, I find a total of 2,054 cases, and 357 deaths, being a proportion of 1 in 5·75.

It should be observed that this table embraces the results of nearly all the various modes of lithotomy ; the apparatus major, the bilateral, recto-vesical, and high operations, are comprised in the table. Besides, a portion of the cases in "private practice," can hardly be admitted as showing the real statistics of lithotomy ; for it would prove, according to M. Civiale, that 106 patients were lost out of 190 operated on by the best surgeons in Paris, between the years 1824 and 1835.

I have therefore endeavoured to form another estimate of the results of the lateral operation in France ; but the number of cases is rather limited. The elements are derived from M. Civiale's work.

RESULTS OF THE LATERAL OPERATION IN FRANCE.

Locality.	Cases.	Deaths.	Proportions.
Paris (private practice) ...	51	21	1 in 2·42
Luneville	365	33	1 — 11·06
Ten Departments of France	110	24	1 — 4·54
Hotel Dieu, 1808-22	39	9	1 — 3·55
La Charité, 1806-22	34	15	1 — 2·26
	582	102	1 in 5·70

A great increase in the number of cases does not, however, alter the proportion much.

Thus, if we take from M. Civiale's table (p. 682) the cases of lateral operation performed in various parts of Europe, we have—

No. of Cases.	Deaths.	Proportion.
2278	443	1 in 5·14

Our returns are not included in this table. If we add them we have the following result :—

	No. of Cases.	Deaths.	Proportion.
M. Civiale's cases	2278	443	1 in 5·14
British cases	1744	251	1 — 6·93
Total	4022	694	1 in 5·79

According to M. Civiale's mode of calculating, the proportion of mortality, derived from his table given above, would be 1 in 4·92, instead of 1 in 5·14.

This difference is explained by the peculiar process which M. Civiale has adopted for establishing his

proportions. He rejects all incomplete cases, and all those in which the cure has not been perfect; yet he retains the whole number of deaths. This method shows correctly the proportion of cures to the number of cases, but it is evidently erroneous when applied to an estimate of the mortality. In a limited number of cases it might increase the relative mortality from 1 in 4 to 1 in 3, that is to say, more than eight per cent.

Having thus proved that the general mortality of lithotomy, taken from a large number of cases (6366), is 1 in 6·64, it becomes necessary to enter into particulars, and show how the proportion of death may vary under particular circumstances.

The principal causes of death after the operation have been already explained, and I have shown that the chances of recovery will be considerably modified by the size of the stone, the condition of the genito-urinary organs, and the tendency to the development of those inflammatory affections from which so many patients die. The probability of a fatal result is increased in proportion to the size of the stone, the diseased state of the organs, and the tendency to inflammation. In early life the influence of these conditions is much less than at later periods. The deposit of calculous matter generally takes place in a slow manner; the longer the foreign body has been present in the bladder, the more likely it is to excite disease; and young subjects are less liable to inflammation of the bladder or kidneys than adults and aged persons. Hence we may anticipate that the mortality of the operation, when performed on children, will be much

below the general average; and statistics prove this to be the case in all countries and under every method.

The table below places this fact in a very clear light. The elements of this table have not been selected. I have taken all the series of cases in which the ages are distinguished into decennial periods, and which from their number offer some guarantee against disturbing influences.

The total number of cases (2,972) is considerable, and a glance at the table shows two important facts—viz., that the number of patients submitted to lithotomy decreases with each decennial period of life, and that the mortality increases at each successive period. Thus below 10 years it is 1 in 13, and thence gradually augments from 10 to 80 years to 1 in 9, 1 in 6, 1 in 5, 1 in 4, 1 in 3·65, 1 in 3·23, 1 in 2·71.

Notwithstanding the favourable results obtained at the Hôtel Dieu and the Norwich Hospital, those of Cheselden and the surgeons of St. Thomas's Hospital

TABLE OF MORTALITY OF LITHOTOMY ACCORDING TO AGE.

Source whence information derived.	Ages.	No. of Cases.	Deaths.	Proportion.
Luneville Hospital	1 to 10	850	58	1 in 10·44
Mr. Smith, Bristol Infirmary	„ „	135	29	1 — 4·65
Mr. Crosse, Norwich Infirmary	„ „	281	19	1 — 14·78
Cheselden	„ „	105	3	1 — 35
Dupuytren	„ „	37	2	1 — 18·50
St. Thomas's Hospital London, 1822 to 1845 ...	„ „	58	1	1 — 58
Total	...	1466	112	1 in 13·08

Source whence information derived.	Ages.	No. of Cases.	Deaths.	Proportion.
Luneville	11 to 20	455	51	1 in 8·92
Crosse...	,, ,,	106	9	1 — 11·77
Smith	,, ,,	65	13	1 — 5
Cheselden	,, ,,	62	4	1 — 15·50
Dupuytren...	,, ,,	17	1	1 — 17
St. Thomas's Hospital ...	,, ,,	26	3	1 — 8·66
Total	...	731	71	1 in 10·20
Luneville	21 to 30	96	15	1 in 6·40
Crosse...	,, ,,	48	5	1 — 9·80
Smith	,, ,,	35	5	1 — 7
Cheselden	,, ,,	12	3	1 — 4
Dupuytren...	,, ,,	7	2	1 — 3·50
St. Thomas's Hospital ...	,, ,,	7	1	1 — 7
Total	...	205	31	1 in 6·61
Luneville	31 to 40	36	9	1 in 4
Crosse...	,, ,,	48	3	1 — 16
Smith	,, ,,	34	7	1 — 4·85
Cheselden	,, ,,	10	2	1 — 5
Dupuytren...	,, ,,	7	2	1 — 3·50
St. Thomas's Hospital ...	,, ,,	6	1	1 — 6
Total	...	141	24	1 in 5·83
Luneville	41 to 50	21	2	1 in 10·50
Crosse...	,, ,,	47	10	1 — 4·70
Smith	,, ,,	37	11	1 — 3·36
Cheselden	,, ,,	10	2	1 — 5
Dupuytren...	,, ,,	4	1	1 — 4
St. Thomas's Hospital ...	,, ,,	4	1	1 — 4
Total	...	123	27	1 in 4·59
Luneville	51 to 60	16	3	1 in 5·33
Crosse...	,, ,,	96	25	1 — 3·84
Smith	,, ,,	28	6	1 — 4·66
Cheselden	,, ,,	7	4	1 — 1·75
Dupuytren...	,, ,,	5	4	1 — 1·25
St. Thomas's Hospital ...	,, ,,	9	2	1 — 4·50
Total	...	161	44	1 in 3·65

Source whence information derived.	Ages.	No. of Cases.	Deaths.	Proportion.
Luneville	61 to 70	18	2	1 in 9
Crosse...	,, ,,	70	20	1 — 3·50
Smith	,, ,,	18	7	1 — 2·57
Cheselden	,, ,,	5	1	1 — 5
Dupuytren...	,, ,,	6	6	6 — 6
St. Thomas's Hospital ...	,, ,,	9	3	1 — 3
Total	...	126	39	1 in 3·23
Luneville	71 to 80	0	0	
Crosse...	,, ,,	8	2	1 in 4
Smith	,, ,,	2	1	1 in 2
Cheselden	,, ,,	2	1	1 — 2
Dupuytren...	,, ,,	2	1	1 — 2
St. Thomas's Hospital * ...	,, ,,	5	2	1 — 2·50
Total	...	19	7	1 in 2·71
Total general	...	2972	355	1 in 8·37

stand out in extraordinary relief. Cheselden lost only 1 patient out of 35 under 10 years; while at St. Thomas's Hospital, during a period of 23 years, the mortality at the same period of life was only 1 in 58. This perhaps is the most brilliant success of which modern surgery can boast; and I cannot but congratulate my esteemed friend, Mr. South, for having afforded us, by the publication of the tables in his translation of Chelius's Surgery, the means of establishing it.

From 50 to 60, and 60 to 70, the relative mortality appears to be very nearly the same; the difference in favour of the former period being a mere fraction, or as 365 to 323. Beyond 70 the number of cases is so

* The age of one adult patient who died is not given.

small, that no deduction can be safely drawn from them. On the 12th of December, 1852, I extracted a calculus from the bladder of a patient in his eighty-first year. He has recovered; and there are but few successful cases so old on record.

ST. THOMAS'S TABLE.

144 Cases in all; in 19 no age given—1 in $9\frac{72}{120}$.

Age.	Cases.	Deaths.	Proportion.
1 to 10	58	1	1 in 58
11 — 20	26	3	1 — 8·86
21 — 30	7	1	1 — 7
31 — 40	6	1	1 — 6
41 — 50	4	1	1 — 4
51 — 60	9	2	1 — 4·25
61 — 70	9	3	1 — 3
71 — 81	5	2	1 — 2·50
Total ...	125	14	1 in 9

Age not given for one death.

The following table of the deaths after lithotomy according to age is taken from M. Civiale; but I have arranged it in a somewhat different manner :—

TABLE OF DEATHS AFTER LITHOTOMY ACCORDING TO AGES.

FROM M. CIVIALE.

Ages.	Cases.	Deaths.	Proportion.
1 to 10	1262	149	1 in 8·47
11 — 20	556	75	1 — 7·41
21 — 30	194	42	1 — 4·62
31 — 40	101	19	1 — 5·32
41 — 50	72	12	1 — 6
51 — 60	80	40	1 — 2
61 — 70	87	46	1 — 1·89
71 — 80	44	20	1 — 1·20
Total ...	2396	403	1 in 5·94

The proportion of deaths at the different periods of life is much greater than that indicated in my own table—a circumstance which may perhaps be explained by what I have already said relative to M. Civiale's method of calculating the mortality from the cases of perfect cure only.

In another table (page 680), which is said to be taken from statistical returns of a more recent date, the mortality is still higher. M. Civiale calculates it at 1 in 4·63 for children up to the age of 14; at 1 in 3·64 for adults between 15 and 60; at 1 in 1·62 for old persons beyond 60 years of age.

It is universally agreed that the size of the calculus exercises a marked influence on the result of lithotomy. Calculi of large size cannot be extracted by the lateral operation without great risk of life, and the other methods present results which are not much more favourable.

The size of the calculus cannot be correctly estimated from its weight, though it may approximatively. The only statistical returns which we possess on this point are due to the late Mr. Crosse, from whose essay valuable information may be derived on nearly everything connected with the history of urinary calculi. Mr. Crosse weighed all the calculi in the Norwich collection, and having compared the weights with the registered results of each case, drew up the following tables:—

INFLUENCE OF WEIGHT OF CALCULUS ON RESULTS OF LITHOTOMY.

FROM MR. CROSSE.

Weight.	Cases.	Deaths.	Proportion.
Up to 1 oz.	529	47	1 in 11·25
1 oz. to 2 „	119	18	1 — 6·61
2 „ 3 „	35	16	1 — 2·18
3 „ 4 „	11	7	1 — 1·57
4 „ 5 „	5	3	1 — 1·66
5 „ 6 „	2	0	0 — 2
6 „ 7 „	2	2	2 — 2
Total ...	703	93	1 in 7·56

WEIGHTS OF CALCULI IN ONE HUNDRED FATAL CASES.

FROM MR. CROSSE.

Weights.	Deaths.
Up to 1 oz.	50
1 „ 2 „	22
2 „ 3 „	17
3 „ 4 „	5
4 „ 5 „	3
5 „ 6 „	0
6 „ 7 „	2
Above 7 „	1

The above returns are highly instructive. They show how rare is the occurrence of a calculus weighing more than 4 or 5 ounces; and, on the other hand, they indicate the influence which the size of the stone exercises on the result of the operation, the mortality increasing in nearly the same ratio as the weight. Seventy-five per cent. of the calculi were under 1 ounce in weight; 17 per cent. under 2 ounces; 5 per cent. under 3 ounces; the proportion of those above 3 ounces was about $1\frac{1}{2}$ per cent.; the remainder a little less than one-fourth per cent.

No statistical records exist which throw any light on the causes of death after lithotomy. This is a strange omission, not easily to be accounted for. Even Mr. Crosse has neglected to investigate the causes of death in the 100 fatal cases for which he has given the weight of the calculi. Perhaps some of the surgeons attached to the Norwich Hospital may be induced to repair this omission. The St. Thomas's tables are equally defective in this point, the cause of death being indicated for a few cases only. Dupuytren is the only writer on lithotomy who has recorded the causes of death; but his results apply to the bilateral method only. The following table has been formed from his notes :—

No. of Cases Operated on.	Cause of Death.	No. of Fatal Cases.
89	Cancer of bladder ...	1
	Sacculated bladder ...	1
	Disease of prostate ...	1
	Obstacles arising from great narrowness of perinæum	1
	Great depth of perinæum	1
	Great size of calculus ...	2
	Nervous accidents ...	1
	Gastro-enteritis	1
	Laceration of prostate...	1
	Hæmorrhage	2
	From infiltration of urine in the cellular tissue of the pelvis	7
Total, 89		19

I will not draw any conclusion from so limited a number of dissections; but I cannot avoid directing attention to the fact which seems to be indicated by

the last element—viz., the frequency of death from inflammation of the cellular tissue of the pelvis. Out of the 19 deaths, 7 occurred from this cause.

In the parallel which I have drawn between the various methods of lithotomy, I endeavoured to discuss the merits and demerits of each in an impartial manner. To complete this part of the subject, I have drawn up a few tables of the mortality of lithotomy according to the methods employed.

MORTALITY AFTER LITHOTOMY.

APPARATUS MAJOR.

Locality.	Cases.	Deaths.	Proportion.
La Charité, 1720–1727	208	71	1 in 2·83
Hôtel Dieu, 1720–1727	604	184	1 — 3·27
La Charité, 1731–1735*	71	32	1 — 2·21
Total	883	287	1 in 3·08

THE HIGH OPERATION.†

Ages.	Cases.	Deaths.	Proportion.
1 to 20 years.	38	9	
20 — 50 „	8	3	
50 — 70 „	18	5	
70 — 80 „	19	6	
Age not indicated ...	21	8	
Total	104	31	1 in 3·35

* Morand, "Traité de la Taille" and "Opuscules de Chirurgie."

† Mr. Humphry, Addenbroke's Hospital, Cambridge.

MORTALITY AFTER LITHOTOMY.

THE BILATERAL OPERATION.*

Ages.	Cases.	Deaths.	Proportion.
1 to 10 years.	15	1	1 in 18
11 — 20 „	3	0	
20 — 50 „	3	1	3 — 5
50 — 70 „	2	2	
Total	23	4	1 in 5·75

LATERAL OPERATION.†

Ages.	Deaths.	Cases.	Proportion.
1 to 10 years.	12	0	
10 — 20 „	5	1	
20 — 40 „	5	0	
40 — 77 „	2	0	
Total	24	1	1 in 24

On adding these tables to those which I have already given, the following view of the mortality according to the method employed is obtained :—

* Report from Professor Eve, of Nashville University, United States.

† Reported by Dr. Gross in his work on "Diseases of the Bladder." One child aged three, died eighteen months after the operation, from disease of the kidney; and a man aged seventy-seven died six weeks after it, from apoplexy.

MORTALITY OF LITHOTOMY ACCORDING TO THE METHOD EMPLOYED.

Method.	Cases.	Deaths.	Proportion.
CHESELDEN'S OPERATION.			
St. Thomas's Hospital ...	144	15	
Bristol Infirmary	375	79	
Leeds Infirmary	197	28	
Norwich Infirmary... ...	704	93	
St. Mary's, Moscow... ...	411	42	
Pennsylvania Hospital ...	83	10	
Cheselden	213	20	
Liston...	115	16	
Total	2242	303	1 in 7·38
APPARATUS MAJOR.			
Hôtel Dieu and La Charité 1721—1731 (Morand) ...	883	287	
Luneville Hospital	1103	119	
Total	1986	406	1 in 4·89
HIGH OPERATION.			
(Frère Come)	69	15	
(Mr. Humphry's Table) ...	104	31	
In all France:— (M. Civiale's Table) ...	95	41	
Total	268	87	1 in 0·08
RECTO-VESICAL METHOD.			
(M. Civiale's table)	185	28	
Total	185	38	1 in 4·87
BILATERAL METHOD.			
Professor Eve	23	4	
Dupuytren	89	19	
Total	112	23	1 in 4

Here Cheselden's operation, as might be expected,

stands at the head of all. The mortality in more than 2,000 cases was 1 in 7·38. The apparatus major comes next, a result for which I confess that I was not prepared. In nearly 2,000 cases the mortality was 1 in 4·89. The recto-vesical follows close on the apparatus major, giving a proportion of 1 in 4·87. Then comes Dupuytren's bilateral operation, with a mortality of 1 in 4 ; and, finally, the high operation, which in 268 cases gives a mortality of 1 in 3·08.

The frequency of urinary calculus at the different periods of life is a point of some interest. M. Velpeau estimates that one-third of calculous patients are children. This estimate, however, is considerably below the true one, as the following tables show :—

FREQUENCY OF CALCULUS AT DIFFERENT AGES.

M. CIVIALE.

Age.	Cases.	Total.	Proportion.
Up to 5 years	896		
From 6 — 10 „	1150	2987	55·56 per cent.
„ 11 — 15 „	555		
„ 16 — 20 „	388		
„ 21 — 25 „	242		
„ 26 — 30 „	218	790	14·69 „
„ 31 — 35 „	162		
„ 36 — 40 „	168		
„ 41 — 45 „	167		
„ 46 — 50 „	224	804	14·95 „
„ 51 — 55 „	159		
„ 56 — 60 „	254		
„ 61 — 65 „	316		
„ 66 — 70 „	261	776	14·43 „
„ 71 — 75 „	138		
„ 76 — 80 „	61		
„ 81 — 89 „	17	17	
	5376	5376	

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From the above table it appears that 55½ per cent. of calculous patients are under twenty years of age; and if we take the word "child" to mean an individual under fifteen years, we have a proportion of 48 per cent. for that period of life. My own table gives a proportion somewhat higher.

FREQUENCY OF CALCULUS AT DIFFERENT AGES.

Age.	Cases.	Proportion.
1 to 20	2327	71.20 per cent.
21 — 40	295	12·40 ,,
41 — 60	355	10·87 ,,
61 — 80	187	5·75 ,,
Total	3164	

In drawing up this table, I have added Mr. Liston's cases, and those from the Leeds Infirmary, to the cases given in a former table. The whole were cases submitted to operation. Those in M. Civiale's table are derived from returns which include the patients not operated on. The difference between the two tables, which are derived from nearly the same sources, would seem to indicate that numbers of adults and aged patients are rejected for lithotomy. As the returns in my own table were drawn up in decennial and bicennial periods, I have not been able to determine the exact proportion of subjects under fifteen years of age.

To complete the statistics, I add a short table of results obtained from private practice. I do not pretend to dispute the authenticity of these returns, having no means of forming a judgment on them, but they

are for the most part evidently exceptional, and for various reasons I have not included them in the general tables.

RECORDED RESULTS OF LITHOTOMY IN PRIVATE PRACTICE.

	Cases.	Deaths.	Proportion.
Dr. Dudley	180	5	1 in 36
Dr. Mettaner	73	2	1 — 36·50
Dr. Warren	30	2	1 — 15
Dr. Gibson	50	6	1 — 8·36
Mr. Martineau	84	2	1 — 42
Clot Bey	58	6	1 — 9·66
Chelius	22	1	1 — 22
Dr. Mott	50	1	1 — 50
Total	547	25	1 in 21·88

The statistics of lithotrity are confined to the results which M. Civiale has published of his own practice. No other surgeon who has performed lithotrity on an extensive scale has given a complete account of all the cases on which he operated. This omission is greatly to be regretted; yet the manner in which M. Civiale's publication was received, both in France and in other countries, was little calculated to encourage other practitioners to follow his example.

I well know that the statistics of M. Civiale have been severely criticised, and that he has been openly accused of serious omissions in the several accounts published by him. I must leave the responsibility of their correctness on that distinguished surgeon, having neither time nor inclination to re-open a discussion which has now been closed for so many years, even in

France. The following is a tabular view of M. Civiale's results :—

1824 to 1846. Calculous Patients.	No. of Operations.	Deaths.	Proportion.
848	591	14	1 in 42·21

The ages in 512 cases were as follows :—

Age.	Cases.
1 to 20 years	25
21 — 40 „	80
41 — 50 „	124
51 — 60 „	44
61 — 80 „	234
81 — 90 „	5
Total	512

This table indicates an immense proportion of aged patients, and if the mortality be, as stated by M. Civiale, one in 42½, the result is of a kind which no lithotomist can pretend to approach.

M. Civiale's statistics embrace two periods, one from 1824 to 1836, during which 305 operations were performed, and the number of deaths was 7. During the second period, from 1836 to 1846, 276 operations were performed, and the number of deaths was also 7.

The first statistical publications of M. Civiale were submitted to a committee of the Institut, composed of Larrey, Double, and Boyer, who thought they detected several omissions in them. The report presented by M. Double has frequently been referred to since then as a proof of want of good faith on the part of M. Civiale; but M. Velpeau, and some of our English writers, have forgotten to mention that these identical statistics, together with the proofs in their support, were again

submitted to the Institut in 1835; MM. Larrey and Double were members of the committee to which the new documents were submitted. They reported on them, and permitted M. Civiale again to state, but this time without contradiction, that he had lost only 6 in 257 cases. This statement was subsequently printed under the authority of the Academy of Sciences, and we may therefore regard it as correct.

In the second series of cases, the mortality is set down by M. Civiale at 7 also. He does not attempt, however, to conceal the fact, that 10 other patients, on whom lithotrity had been commenced, died. These patients were not included in the general table, because the operation had not been persevered in, the cases after a few trials having been found unsuited for lithotrity. Many may be disposed to think that they should have been comprised in the general table, and if this had been done, we should have had a total of 591 operations, and 24 deaths, or 1 in 24 : a result with which the most sanguine advocates of the method may be content.

Lithotrity has been frequently performed in France by MM. Leroy d'Etiolles, Heurteloup, and Amussat, but they have not published a complete account of their cases. Of those given by M. Leroy, we find 11 deaths in 116, while M. Heurteloup asserts that he lost only 1 patient in 38. Of the first 112 operations performed in Italy, 9 proved fatal.

Professor Campanella states that 10 patients were treated by lithotrity in the hospital of Loretto between 1834 and 1839, and all recovered. Seven of them were above 40 years of age.*

* Repertorio di Piemonte. August, 1839.

In the following table the results of lithotomy and lithotrity are not distinguished. *

Loretto Hospital.	Cases.	Males.	Females.	Deaths.
1821 to 1838.	596	579	17	91

Proportion, 1 in 6·43

Children	...	...	...	306
Adults	...	...	...	231
Old People	...	...	...	59
Total	...	...		596

In this country we have contributed little or nothing to the statistics of lithotrity. Sir Philip Crampton, and Mr. Teale, of Leeds, are the only surgeons who have published an account of the whole of the cases which occurred to them. In this particular they merit praise, but no conclusion can be drawn from their limited number of cases ; and I say this with great respect for these excellent surgeons.

* Filiatro Sebezio. July, 1839.

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